Section 13
Recommended Program

13.1 Introduction

The Town recommended wastewater program includes a collection and conveyance system and two centralized treatment facilities. Each of these components would be phased in over 40 years. For this program, the treatment option utilizes the existing facility in Chatham and a new facility constructed in Harwich. The implementation of such a program will allow Harwich to meet its water resource management needs as defined throughout this report, including consistency with the MEP nitrogen reduction goals as well as the protection of freshwater resources including ponds and drinking water resources. This section describes the recommended program components for the collection and conveyance systems, wastewater treatment, and effluent recharge. It also proposes a wastewater phasing plan for implementation and notes a potential cost recovery strategy that is being developed by the Town with details still to be developed. This section also describes the recommended non-infrastructure program components which include fertilizer and stormwater management programs, potential land use changes, and several community involved conservation and pollution reduction programs.

This section summarizes the final Comprehensive Wastewater Management Plan (CWMP) recommended program, includes a plan for an adaptive management strategy to meet and adjust to MEP goals and provides a description of alternatives to this plan that were evaluated.

13.2 CWMP Recommended Program to Meet MEP Requirements, Traditional Resource Management Needs and Other Town Needs.

The CWMP Recommended Program is a comprehensive plan designed to address nitrogen loading to the local embayments along with other related issues such as drinking water supply protection, growth management and support of local planning and development initiatives. This program is proposed for implementation over a 40 year period.

In Section 10, eight collection and treatment scenarios (1A to 8A) were evaluated for their applicability in Harwich based on the current and future community development and the Total Maximum Daily Loads (TMDL) for nitrogen in each of the five embayments. These evaluations considered a broad range of scenarios and screened them to three scenarios (3A, 4A and 5A) to be evaluated for further detailed evaluation. Section 12 provided that evaluation and considered the additional details for each scenario. It identified the most appropriate collection system and treatment technology and recommended a collection and treatment system that was used to develop planning costs. Scenario 5A was ultimately recommended as the preferred scenario because it allows for multiple effluent recharge sites in different watersheds, allows for easier phasing with adaptive management, presents a regional solution between the Towns of Harwich and Chatham, and reduces the overall size of the facilities in Harwich.

Highlights of Scenario 5A:

- Allows for effluent recharge sites in multiple watersheds;
- Provides a phasing plan that utilizes an existing treatment facility;
- Presents a regional solution between Harwich and Chatham; and
- Reduces the size of new facilities in Harwich.

In addition to the proposed sewering, the recommended program allows for desired higher density development in the East Harwich Village Center, Harwich Center and the Harwich Port areas and recommends continued maintenance of Title 5 systems in several areas of town including the areas north of Route 6 and the area east of the Saquatucket Harbor watershed. Each of these items is described in detail herein.

13.2.1 Recommended Sewer System Master Plan

The recommended sewer system master plan is shown on Figure 13-1. It provides a town-wide perspective of the areas recommended for sewering. Figure 13-2 shows the amount of septic system nitrogen required to be removed to meet the proposed TMDL in each watershed which is achieved by the recommended master plan.

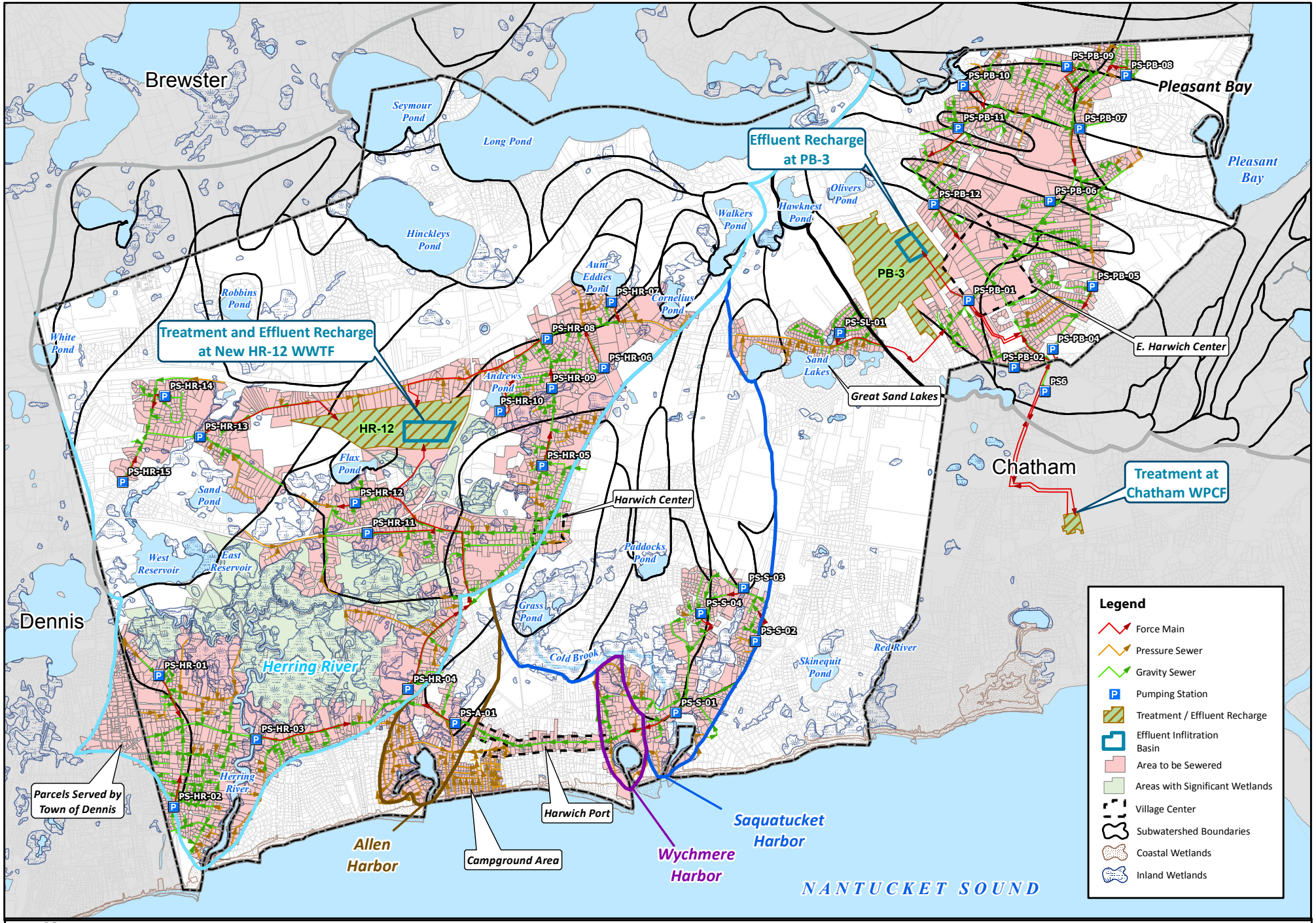
The recommended plan provides collection and conveyance, treatment, and effluent recharge for about 1.26 mgd of annual average day flow of wastewater from the MEP Watersheds and other selected portions of Harwich. This is a future flow projection developed from the buildout analysis in the MEP models with assistance and updates from the Harwich Planning Department. The buildout flow is projected to be about a 25 percent increase over the current wastewater flow.

13.2.1.1 Scenario 5A with Additional Wastewater Collection Areas

The recommended plan utilizes Scenario 5A which includes sewer collection areas in the MEP watersheds of the Allen, Wychmere and Saquatucket Harbors, the Pleasant Bay, and the Herring River plus it includes some other wastewater needs areas located outside of MEP studied watersheds. Thus, this plan modifies the Scenario 5A plan evaluated in Section 12 by including updates to the existing MEP buildout estimates for the East Harwich Village Center in Pleasant Bay, the Route 28 corridor including the Harwich Port area, the Great Sand Lakes area and the campground area. Each of these modifications is described below in more detail.

East Harwich Village Center (EHVC)

The East Harwich Village Center is already targeted for sewering under Scenario 5A, but the projected buildout wastewater flow determined for the MEP in this area does not account for the higher density village center planning concept currently being considered for this area. While the MEP included some additional flow for this area at buildout, it was not sufficient to accommodate the current planned redevelopment of the EHVC. Thus, wastewater flow generated from an additional 250 residential housing units and 500,000 square feet of commercial space has been included for planning purposes in the final estimate of wastewater flow. This amounts to an additional 55,000 gallons per day of wastewater flow at buildout. Each of the 250 units is estimated to contribute approximately 150 gallons per day of wastewater flow to the system. The commercial space is expected to contribute 35 gallons per 1,000 square feet of commercial space based on existing Pleasant Bay MEP data.



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Town of Harwich
Comprehensive Wastewater
Management Plan

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 13-1
Recommended Areas to be Sewered

CDM Smith

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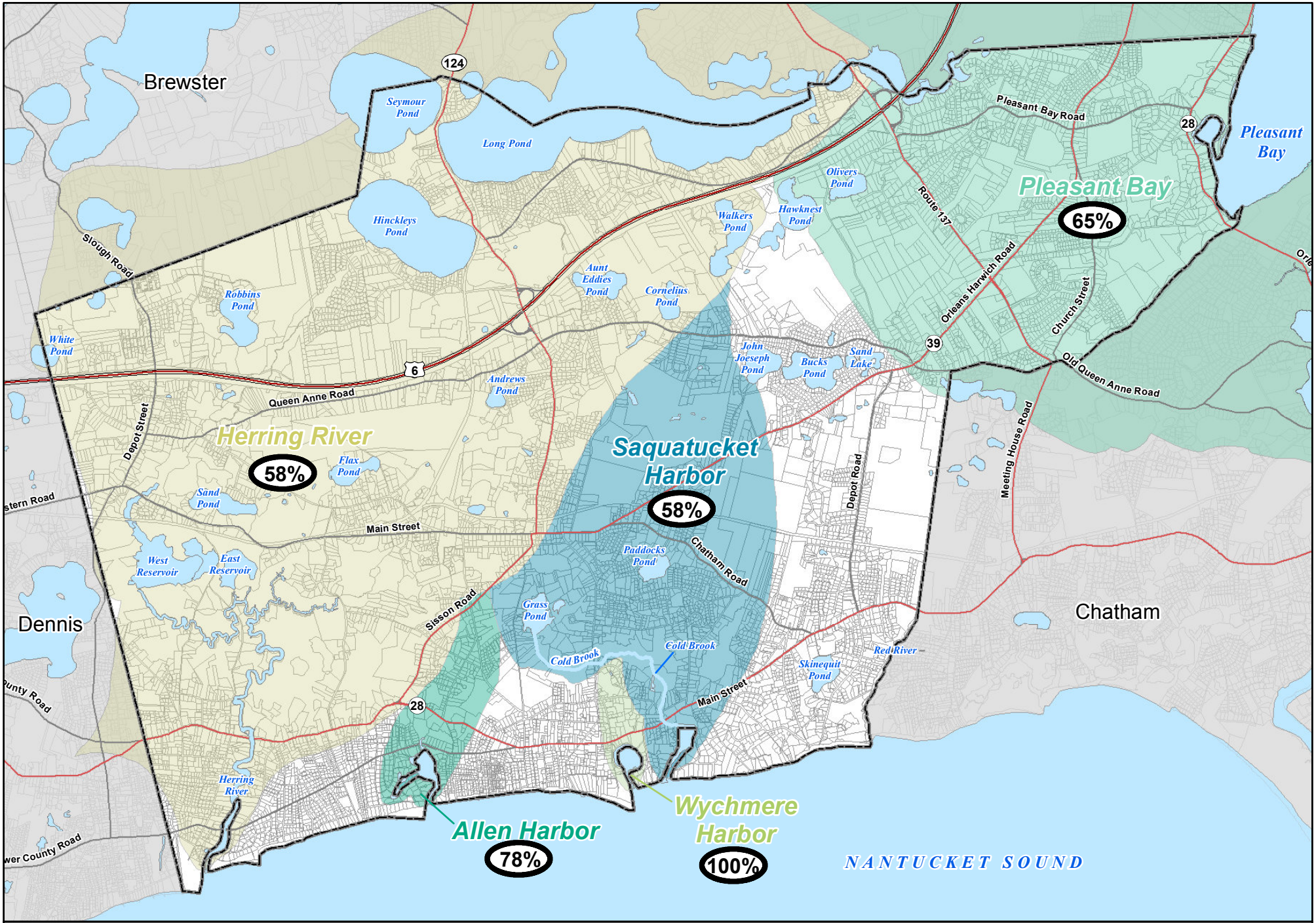

Town of Harwich
Comprehensive Wastewater
Management Plan

Figure 13-2
Watershed Septic Load Reductions

CDM Smith

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Route 28 (Including Harwich Port)

Similar to The East Harwich Village Center, a significant portion of Route 28 is already proposed for sewering under Scenario 5A. The future flow for this area, as determined by the Harwich Planning Department, indicates that the Route 28 corridor from the Saquatucket Harbor to the Dennis town line is likely to experience a 20 to 25% increase in flow at buildout conditions. Similarly, higher density development is being considered for the Harwich Port Village area and in order to make that viable, sewers would be needed. Pipelines would be installed in that area anyway in order to connect the Wychmere Harbor area to the east over to the Allen Harbor area to the west. Thus, for planning purposes a 25% increase in flow along Route 28 and the Harwich Port area have been included in the recommended plan.

Great Sand Lakes Area

The Great Sand Lakes Area is not part of a MEP studied watershed. The recommended plan includes this area as a way to protect Bucks Pond and John Joseph Pond as discussed in the pond management alternatives in Section 5 of this CWMP. The upgradient areas of these ponds are densely developed creating the potential for phosphorus to leach from the septic systems into the freshwater ponds resulting in degraded water quality. Because of the dense existing development in this area, only a 5% increase above existing flow has been carried for buildout conditions for the Great Sand Lakes area.

Campground Area

The Campground Area also is not part of an MEP studied watershed. The recommended plan includes this area as a way to deal with significant Title 5 issues that are frequently encountered as a result of the high groundwater and small lots in this area as discussed earlier in Section 8. As a result, the Harwich Health Department has had to issue several Title 5 waivers in this area to accommodate the existing development. By sewering this area, the Title 5 septic system waiver issues will be eliminated. Because of the dense existing development in this area, only a 5% increase above existing flow has been carried for buildout conditions for the Campground Area.

13.2.2 Neighboring Towns with Shared MEP Watersheds

Harwich shares MEP watersheds with the Towns of Dennis, Brewster and Chatham. All share some responsibility for nitrogen inputs to either the Herring River and/or the Pleasant Bay Embayment systems. Because of this, nitrogen management must be shouldered by all parties who contribute to the problem. In many cases it is considered inefficient for each town to separately manage its individual contribution of nitrogen to the impaired embayment. Typically, it is more efficient for the communities to work regionally to address the nitrogen issue within a given watershed. Brewster, as an example, shares the Herring River watershed with Harwich and is responsible for approximately 15% of the buildout septic load in that watershed. Since the Herring River watershed within Brewster's town boundaries is located in a less developed part of Brewster, it is likely less efficient (from a wastewater collection and treatment perspective) to manage wastewater generated there than in the more densely developed areas of the Herring River watershed in Harwich. As an alternative for wastewater management, the Town of Brewster may want to partner with Harwich on the operation of their collection and treatment facilities to determine a solution that will benefit both towns and achieve regulatory compliance. Several solutions should be evaluated that may include nitrogen trading (if possible), one time infrastructure payments, long term nitrogen management payments or

possible inter-municipal connections that convey wastewater and treated effluent across town lines for treatment and recharge at different locations.

The list below details how the Towns of Dennis, Brewster, and Chatham have been addressed within the context of the Harwich recommended plan and how it relates to the overall program. It is important to note that the Town has already initiated informal conversations with its neighboring communities to discuss wastewater management, but no formal agreements have been established at this time. While the recommended plan presented in this section addresses how to achieve the TMDL limits in the embayments of the Allen, Wychmere, Saquatucket, Pleasant Bay, and Herring River, it does not completely address how each town will address its share of the responsibility. Those issues will be formalized at a later date.

Brewster

Brewster shares a portion of the Herring River and Pleasant Bay watersheds with the Town. The recommended wastewater plan presented herein assumes that the Town of Brewster will not initiate any wastewater infrastructure management in the Herring River watershed. It also assumes that Brewster will address their own nitrogen load contribution to Pleasant Bay via a wastewater infrastructure management plan within their town boundaries. Since Brewster is currently developing their wastewater management strategy, these assumptions may change and will be verified as their master plan is developed.

Dennis

Dennis shares a small portion of the Herring River watershed with the Town. The recommended plan presented herein assumes that the Town of Dennis will collect wastewater in their densely developed area and will recharge the treated effluent in a watershed outside of the Herring River watershed. Similar to Brewster, the Town of Dennis is also developing a wastewater management plan and this assumption will be verified as their master plan is developed.

Chatham

Chatham shares a significant portion of the two Pleasant Bay sub-embayments (Upper Muddy Creek and Lower Muddy Creek) with the Town. The Recommended Plan presented herein assumes that the Town of Chatham will initiate wastewater collection and treatment for the septic load that is generated within the Pleasant Bay watershed. This assumption reflects the wastewater master plan presented in the approved Chatham CWMP. The two towns are already working regionally on widening the Muddy Creek bridge opening for habitat restoration and improved flushing and are in discussions about using the recently upgraded and expanded Chatham wastewater treatment facility as part of the Harwich recommended plan.

13.2.3 Recommended Collection System Technology

As discussed in more detail in Section 12, the recommended system for the Town is a hybrid system utilizing gravity sewers supplemented with pumping stations at low points and low pressure sewers in small areas. In this system, gravity collection would be utilized as much as possible to decrease the overall cost of conveyance and to best handle the large swing in seasonal and commercial/ residential flows. The gravity system will be supplemented with pumping stations and low pressure sewers in the areas where appropriate to help minimize costs. Typically, if an area with low pressure sewers exceeded more than 20 to 25 homes, a gravity system with a small pumping station will be utilized. In

smaller neighborhoods, with less than 20 homes, or at the end of streets where topography drops down low pressure sewers will be utilized to collect the flow and then discharge into a gravity pipeline.

13.2.4 Recommended Treatment Technology

Harwich

The recommended treatment technology for the Harwich treatment plant to be built at Site HR-12 is a Sequencing Batch Reactor (SBR) process as discussed in more detail in Section 12. The SBR option is cost-effective, easily expandable, able to treat to stringent permit limits, and is easily operated. As the collection system expands and potential future regulations are revised, the option to continue forward with the SBR processes maximizes flexibility. This process allows for the future option of adding more SBRs and operating as an SBR facility, or adding membranes, if required, downstream of the SBRs. This would allow the facility to operate as a hybrid SBR/MBR facility as regulations become stricter and advancements in technology lead to improved treatment options. This process will also allow Harwich to produce an effluent with a total nitrogen level of 3 mg/L.

It is also recommended that when the initial phase treatment plant is built at Site HR-12, that a pilot demonstration project be conducted utilizing a Permeable Reactive Barrier (PRB) around one of the infiltration basins. PRB's provide a carbon source for denitrification to take place in the recharged effluent. The resultant nitrogen decrease may allow for a reduction in the Herring River Watershed sewer service area.

Chatham

The wastewater treatment facility in Chatham was recently upgraded and expanded as part of their first phase wastewater program. It has a treatment design capacity of 1.3 mgd with the ability to expand to 1.9 mgd which is the buildout flow needed for Chatham. The Chatham WPCF (Water Pollution Control Facility) utilizes an oxidation ditch treatment process to treat influent wastewater to a total nitrogen level of 3 mg/l. The existing Groundwater Discharge Permit limits the effluent recharged on-site in infiltration basins to 1.0 mgd. Existing flows are less than 0.2 mgd.

13.2.5 Revised System Wide Flows

Build-out wastewater flows were calculated from the MEP model, water use records and input from the Town. The MEP, working with Harwich planning staff, developed a buildout estimate for the Town as part of its nitrogen loading model. The buildout estimate took into account the Town's planning data, zoning and land use classifications. In areas such as Harwich Port, The East Harwich Village Center, the Route 28 Corridor, and the Campground Area the Town updated the buildout estimates as discussed earlier in Section 13.2.1. Those revisions are presented in Table 13-1 below.

Revised Flows in the East Harwich Village Center

In the East Harwich Village Center (EHVC), updates were made to the MEP buildout assumptions. The town is evaluating options to increase development in this area and several options remain under consideration. After discussions with local boards, committees and town staff it was decided for planning purposes to include 250 new residential units and 500,000 square feet of new commercial development *above* the existing MEP buildout estimates.

The MEP buildout estimates are the result of meetings with the Town planning staff that took place in 2006. The MEP staff developed the buildout estimates for the Pleasant Bay watershed based on the existing zoning and the Harwich planning departments understanding of potential future development. The MEP report detailing those estimates was then issued (in 2006). Then in 2011, the Town Local Comprehensive Plan was completed and approved by the Town. In the 2011 Local Comprehensive Plan, the EHVC was specifically targeted for zoning revisions that would result in updated buildout projections not found in the 2006 MEP report.

The approval of the Local Comprehensive Plan prompted the development of a new buildout scenario detailing the updated flows in the East Harwich Village Center. These updated buildout flows were endorsed by the Harwich Planning Department in 2012 and are incorporated into the recommended plan.

After discussions with Planning Department and the Water Quality Management Task Force-Wastewater Management Subcommittee it was decided to include the buildout flows developed in the Local Comprehensive Plan to the buildout flows developed in the 2006 MEP report. The additional buildout flow of 55,000 gpd is considered appropriate for planning purposes since any zoning revisions for the EHVC are not final at this time. Thus, the projected MEP buildout flow for the sewer service area in the Pleasant Bay of 235,900 gpd was increased by 55,000 gpd up to 290,900 gpd based on 250 additional residential units at about 150 gpd/unit and additional commercial development at 500,000 square feet at the existing 35 gpd/1,000 SF. These wastewater flow values are from the MEP model and are specific to a given watershed.

Table 13-1 presents the wastewater flows estimated for each area recommended to be sewered, under both current and buildout conditions using the best available data. The entire sewer service area is expected to have an initial annual daily average wastewater flow of 0.86 MGD and a buildout annual daily average wastewater flow of 1.08 MGD. The resultant total wastewater flow including I/I is 0.97 mgd (0.86 + 0.11 mgd) for current annual average day flow and 1.26 mgd (1.08 + 0.18 mgd) for buildout annual average day flow. In the buildout scenario, the I/I for the Pleasant Bay area was not significantly increased because of the potential increased use of pressure sewers planned for this area.

Compared with Scenario 5A presented in Section 12, the recommended plan increases the buildout wastewater flow by about 150,000 gpd which represents a 16% increase in wastewater flow. The percent growth or buildout is shown in the table for each individual watershed or additional sewer service area. The overall buildout percent is about 26% or 220,000 gpd in wastewater.

The number of parcels In Table 13-1 presents the number of lots, by watershed, served by the wastewater collection and treatment system in the recommended plan. These lots were selected from a town GIS layer developed in 2006. It is the same GIS layer that was utilized in all of the Harwich MEP reports. Although some changes such as subdivisions have likely occurred between 2006 and 2012, the lots presented in the recommended plan are very similar to the map and lot database maintained by the Harwich Assessor's office.

Table 13-1
Recommended Plan Wastewater Flows (Scenario 5A with Additional Areas and Build-out Update)

Watershed	Number of Parcels	Percent Growth	Current Annual Average Wastewater Use (GPD)	Current Average Estimated I/I Flow (GPD)	Build-out Annual Average Wastewater Use (GPD)	Build-out Average Estimated I/I Flow (GPD)
Allen	234	9.4	52,100	2,250	57,000	4,500
Wychmere	123	10.3	26,300	1450	29,000	2,900
Saquatucket	415	5.0	90,700	9,000	95,200	18,000
Pleasant Bay	1,205	41.3	205,900	34,900	290,900	35,000
Herring River	2,340	29.2	399,300	56,000	515,700	112,000
Route 28 – Outside MEP Watershed	93	24.3	20,600	*800*	25,600	*1600*
Great Sand Lakes	269	3.3	32,900	*800*	34,000	*1600*
Campground Area	267	3.1	32,000	*800*	33,000	*1600*
Total (Rounded)	**4,950**	**26**	***860,000***	***110,000***	**1,080,000**	***180,000***

When the MEP developed buildout projections, it estimated future flows for each parcel but did not change the number of parcels in their GIS layer. As a result, the number of parcels in the recommended plan presented in this section is the same under both present day and buildout conditions. While the MEP did not develop subdivision lots in its buildout estimates, several are expected which will change the total number of parcels in the service areas. The MEP did include buildout flow projections by dividing parcel sizes by current zoning.

13.2.6 Treatment Facility Flows and Nitrogen Limits

To develop the flows for the HR-12 treatment facility to be located in the Herring River watershed, peaking factors were applied to the anticipated annual average daily wastewater flows. The ratio of summer (June, July and August) to annual average daily flow was determined to be 1.91 from monthly well pumping records. To evaluate low flows, the ratio of winter to annual average daily flow was determined to be 0.52. Table 13-2 shows the design flows for the Harwich wastewater treatment facility at buildout. The buildout annual average day flow to be treated is approximately 0.90 mgd which is the 1.26 mgd minus the flow sent to Chatham from the Pleasant Bay and Great Sand Lakes areas (or about 0.36 mgd). The design flows for the Chatham WPCF are not presented here because that facility has adequate capacity at this time and any required upgrades are not anticipated for several years.

Table 13-2
HR-12 Facility Estimated Design Flows at Build-out

Flow Scenario	HR-12 WWTF at Build-out
Average Day Total Wastewater (MGD)	0.90
Peak Hour Flow (MGD)	5.34
Maximum Day Flow (MGD)	3.32
Summer Average Flow (MGD)	1.59
Winter Average Flow (MGD)	0.53

The Harwich wastewater treatment facility will be constructed in two phases as discussed in Section 13.4. The first phase of the facility will be designed to accommodate a flow smaller than the buildout flow and will need to be expanded in a later phase.

Phase 1 of the Recommended Plan is not a “collect and treat” wastewater solution and Phases 2 and 3 will utilize the Chatham Water Pollution Control Facility (WPCF).

The initial HR-12 treatment facility in Harwich will be constructed in Phase 4 and will allow the Town to construct phases 4 to 6 of the wastewater collection system. An expansion will be needed at the Harwich facility to bring phases 7 and 8 online. The annual average flow to the fully expanded HR-12 treatment facility is approximately 900,000 gpd (1.26 mgd minus flow to Chatham) and will serve about 3,500 parcels. (See Figure 13-1)

As discussed earlier, the MEP reports and the Recommended Plan indicates that the effluent recharge for the Herring River and the Pleasant Bay must be treated to a total nitrogen concentration of 3 mg/l to minimize the extent of the wastewater collection system. As a result, the final treatment facilities will be designed with a 3 mg/l limit. At HR-12, this will equate to 54,344 lbs/yr (24,650 kg/yr) of

nitrogen removed from the areas tributary to that facility and will result in an ultimate discharge of 6,899 lb/year of total nitrogen (3,129 kg/year) that will be recharged to the HR-12 site in the Herring River watershed (0.76mgd X 3 mg/l X 8.34 = 18.9 lbs/day). Addition of a PRB may help to further reduce the nitrogen load at this site.

At PB-3 this will equate to 23,370 lbs/yr (10,600 kg/yr) of nitrogen removed from the areas tributary to the Chatham facility (Harwich flow only) and will result in an ultimate discharge of 2,967 lb/year of total nitrogen (1,345 kg/year) that will be recharged to the PB-3 site in the Pleasant Bay watershed (0.32 mgd X 3 mg/l X 8.34 = 8.1 lbs/day).

13.3 Updated Capital and O&M Costs

Cost estimates were developed for the final recommended collection and treatment system.

13.3.1 Collection System Capital Costs

Cost estimates for the hybrid sewer collection system including both piping, pumping stations, and low pressure pumping units are shown in Table 13-3.

Table 13-3
Estimated Collection System Capital Costs

Collection System Capital Costs	Recommended Plan
Number of Parcels Served	4,950
Collection System Cost	$154,400,000
Collection System Cost in Chatham (Harwich Share of System developed by GHD)	$2,400,000
Total (rounded)	**$156,800,000**
Homeowner Hookup Cost	$21,900,000

The cost for gravity piping includes pipe, manholes, wye connections for each parcel, 6-inch service connections extending an average of 20 feet for each lot (from centerline of the street to the property line), excavation support, state highway construction considerations where applicable (flowable fill, etc.), paving, police details, and some allowances for drainage and mobilization. Paving is assumed to include a 2-inch trench patch and a 1.5-inch full width overlay on all currently paved roads. The cost for individual homeowner hookups (pressure and gravity) is also included, but it is not carried forward in the capital costs. For the homes or businesses with pressure sewers, an additional cost was included for the purchase and installation of a grinder pump. The approximate breakdown is 1,350 parcels at $7,000 per to include pressure sewer connections and 3,550 parcels at $3,500 per gravity connection. The town may decide to pay for the pressure pump unit which is about half of the $7,000 hook-up cost.

The collection system costs for facilities in Chatham were developed by GHD Consulting Engineers as they planned the system for the Town of Chatham. These costs are for the Harwich share of wastewater pumping stations and pipelines to convey the wastewater from the Harwich/ Chatham line to the wastewater treatment facility. Costs for conveying effluent back to Harwich are included in the collection system costs as detailed in Section 12.

13.3.2 Treatment Facility Capital Costs

The treatment costs are presented below in Table 13-4. Those costs were based on annual average flows but increased to account for the large seasonal flow swings characteristic of a resort community like Harwich. A cost for effluent recharge facilities was included and assumed that open infiltration basins will be utilized for effluent recharge at both Sites HR-12 and PB-3. Site HR-12 is Town owned so only a cost allowance of $250,000 to purchase 10 acres at Site PB-3 was carried ($25,000 per acre for back land)

Table 13-4
Estimated Treatment Facility Capital Costs

	Recommended Plan
Chatham Treatment Facility Expansion Cost	$9,200,000
HR – 12 and PB-3 Facility Cost	$56,300,000
Total	**$65,500,000**

All of these estimates include an allowance for planning level costs (15 percent), and for permitting, engineering and construction services (25 percent).

GHD Consulting Engineers developed the costs for the Chatham treatment plant expansion to accommodate about 300,000 gpd of flow from Harwich. The final flow value is still to be confirmed.

13.3.3 Treatment and Collection System Capital Cost Summary

In Table 13-5, the estimated total capital cost for collection and treatment is presented. The project costs presented in this table are from July of 2012 with an Engineering News Record (ENR) index of 9323.

Table 13-5
Estimated Collection and Treatment System and O&M Annual Costs

Option	Scenario 5A
Total Collection System Cost (Harwich and Chatham)	$156.8 Million
Total Treatment System Cost (Harwich and Chatham)	$65.5 Million
Total Cost	**$222.3 Million**

13.3.4 Chatham Treatment Facility O&M Costs

O&M costs for conveyance and treatment from that location to the Chatham WPCF were also determined by Chatham and their engineer, GHD Consulting Engineers, using the planning level costs developed earlier in the Chatham CWMP. Costs developed are shown in table 13-6, below. A copy of the technical memorandum detailing the regional connection alternative to Chatham is included in Appendix E.

Table 13-6
Town of Harwich Share of the Collection and Treatment System Costs to connect to the Chatham System

Type	Recommended Plan
Annual O&M Costs	**$ 260,000**

13.3.5 Harwich Collection System O&M Costs

Annual operation and maintenance collection systems costs for the recommended plan under buildout conditions are shown below in Table 13-7. These costs have been divided into system wide costs and a summary of individual user costs that the property owner would normally pay. These costs are for operation of the collection system in Harwich only and do not include operation and maintenance costs associated with the Town's proposed wastewater treatment facilities.

Following the table is an explanation of the basis of the labor, equipment, power and other costs presented in the table.

Table 13-7
Operation and Maintenance Cost Summary for Build-out Conditions

Cost Category	Recommended Plan
Public Costs:	
Labor	$590,000
Power	$168,000
Miscellaneous Costs	$152,000
Total System Wide O&M	**$910,000**
Private User O&M Costs	$170,000

[1]Does not include wastewater treatment charges.

Labor Costs

The average cost for labor including salaries and fringe benefits is approximately $65,000 per employee per year. The recommended plan indicates that Harwich's labor force will include a total of nine people to maintain the collection system which includes thirty-four pumping stations at buildout.

Proposed Gravity System

To determine the number of personnel required for the gravity sewer system, the number of miles of sewer and the number of pumping stations was calculated. The proposed gravity system is expected to require a labor force of approximately seven people. These staff will be needed to perform operation and maintenance of thirty-four (34) wastewater pumping stations, and approximately fifty-one (51) miles of gravity sewers.

Proposed Pressure System

The majority of the pressure system maintenance cost is directly on the connection owner. The proposed pressure system is expected to require a labor force of approximately two people to maintain the pressure system.

Power Costs

Power costs are based on connected horsepower and expected running times of pumps at all of the wastewater pumping stations. Annual costs were calculated for the 34 pumping stations utilizing the gravity sewer option. Operational costs for the pressure sewers were not considered in the power costs because the Town is only responsible for the main pumping stations and homeowners operate and maintain the grinder pumps.

Miscellaneous Costs

These costs include spare parts, vehicles, fuel and associated maintenance, training expenses and other miscellaneous costs. Since Harwich has no existing budget to review we estimated that miscellaneous costs are likely to represent 20% of the labor and power cost.

Private Costs

Pressure Sewer System

Every household has an on-site grinder pump that is owned, operated and maintained by the homeowner. The costs include $25/year for power and an allowance to purchase a service contract to maintain the system at $100/year for a total of $125/year per household.

13.3.6 HR-12 Treatment Facility O&M Costs

Estimated annual operation and maintenance costs for the Harwich HR-12 treatment facility is shown below in Table 13-8. These costs were developed based on engineering estimates and a review of a few communities in Eastern Massachusetts. They are also similar to the treatment facility O&M estimates presented in the "Comparison of Costs for Wastewater Management Systems Applicable to Cape Cod" prepared by the Barnstable County Wastewater Task Force in April 2010.

Table 13-8

Estimated HR-12 Treatment Facility O&M Costs

Item	O&M Cost
No. of Staff	7
Labor	475,000
Benefits	240,000
Maintenance	160,000
Chemicals	110,000
Electricity	450,000
Grit/Sludge Disposal	180,000
Other/Misc	175,000
Total (Rounded)	**$1,800,000**

13.3.7 Treatment and Collection System O&M Costs Summary

Annual operation and maintenance costs for the recommended plan are shown below in Table 13-9. These costs are for operation and maintenance of both the collection and treatment systems associated with the Town's proposed wastewater treatment facilities. These costs represent the

estimated annual costs to operate both treatment facilities at 1.26 mgd of annual average day buildout flow.

Table 13-9
Estimated Collection and Treatment System Annual O&M Costs

Option	Scenario 5A
Treatment System O&M (Chatham Facility)	$260,000
Collection System Public O&M	$910,000
Treatment System O&M(HR-12 Facility)	$1,800,000
Total Town Costs (rounded) (No Private O&M)	**$3.0 Million**

The assumptions used in this estimate for other costs are based on operations and maintenance experience at several similar facilities. A number of factors can affect these budget numbers such as specific town requirements or preferences, outsourcing to private operators, sharing of regional facilities, variations in wastewater quality, and specific treatment goals and guidelines for each individual facility.

13.3.8 Recommended Program Cost Summary

In Table 13-10, the estimated total capital cost is presented along with the estimated total O&M cost. For comparison an Equivalent Annual Cost (EAC) is presented. The equivalent annual cost assumes that the capital cost is based on a 20 year loan with a 2% interest rate that assumes the standard State Revolving Fund (SRF) is the funding mechanism for the project. Some SRF loans are now being done up to 30 year loans.

The project costs presented in Table 13-10 have been escalated with an Engineering News Record (ENR) index of 9475, to April 2013 for consistency.

Table 13-10
Estimated Collection and Treatment System and O&M Annual Costs

Option	Scenario 5A
Collection and Treatment Capital Costs	$222.3 Million
Collection and Treatment Capital Costs (Escalated)	$226 Million
Capital Equivalent Annual Cost (EAC)	$13.8 Million
Collection and Treatment O&M Cost	$3.0 Million
Total Equivalent Annual Cost	**$16.8 Million**

13.4 Wastewater Phasing Plan

Since the overall wastewater plan in the CWMP cannot be constructed as one project and will take several years to construct, a phasing plan is required. This will ensure that the wastewater plan (which is a combination of several smaller projects) progresses efficiently while meeting the needs of the Town including economic development of town centers, dealing with financial impacts, minimizing traffic impacts, and addressing environmental protection.

13.4.1 Wastewater Phasing Plan Issues

There are several issues that need to be considered in developing the phasing plan for implementing the recommended wastewater program in the Town. The CWMP addresses many of these issues but conditions and priorities will change over the next 40 years that will impact current day decisions. Thus, the phasing plan will need to be constantly monitored and periodically modified as it is implemented via a process known as adaptive management.

Current issues that need to be considered in developing the phasing plan include:

1. Title 5 septic system issues
2. Freshwater ponds water quality
3. Drinking water wells water quality
4. Future growth and economic development potential
5. Regionalization opportunities
6. TMDL (MEP) issues
7. Program Costs

Title 5 Septic System Issues

As discussed in earlier sections (Sections 3 and 8), the Town has relatively good soils throughout for Title 5 subsurface disposal septic systems. With almost all parcels in Town on municipal water, the majority of septic system waivers are for setback requirements due to small lots in specific areas. Thus, only two areas were identified as Title 5 Areas of Concern and they include the area along Route 28 north of Allen Harbor and the Campground Area just east of Allen Harbor. As Title 5 is not a main driver for sewering in town, these areas should be planned for sewering when adjacent areas are to be sewered.

Freshwater Ponds Water Quality

As discussed in earlier sections (Sections 5 and 8), there are 63 freshwater ponds and lakes in town. Some of them have been part of a water quality monitoring program for several years while others have little known data on them. Based on known data there are some areas that should be sewered to remove the phosphorus source from septic systems that are entering the nearby freshwater source. These areas include the Great Sand Lakes area, and potentially areas around Long Pond, Seymour Pond and Paddocks Pond. As data becomes available on other ponds they may be added to this list. These areas should be considered for sewering when adjacent areas are being addressed. Local solutions may also be considered for higher priority ponds.

Drinking Water Wells Water Quality

As discussed in earlier sections (Sections 4 and 8), the Town overall has excellent water quality in their groundwater wells. The Town over the years has done a good job of protecting lands where their well zones of contribution are located. The only wells that show a slight increase above typically background levels for nitrogen are located in the Pleasant Bay watershed. Those areas should be considered for sewering in earlier phases when the Pleasant Bay watershed is sewered.

Future Growth and Economic Development Potential

As discussed in earlier sections (Sections 3 and 8), the Town is looking to create more of a village center in the East Harwich Commercial Development area and to a lesser degree in Harwich Center and in Harwich Port. This type of planning concept requires higher density development than can be supported by typical Title 5 septic systems and so appropriate infrastructure needs to be installed to support the change along with appropriate changes to zoning and other utilities (traffic, water, etc.). It is likely to take several years for these concepts to evolve and for appropriate development to then occur. Infrastructure improvements are often needed first to allow the development to take advantage of the changes; however, public and private partnerships can be utilized to achieve this purpose. Therefore, it would appear that the timing of when the infrastructure is needed in these areas in order to support the desired development along with when sewers are to be installed in adjacent areas will be the driving forces for when these areas are to be addressed in the phasing plan.

Regionalization Opportunities

As discussed in earlier sections (Section 10 and 12), the Town has an opportunity to partner with the Town of Chatham by utilizing the Chatham Water Pollution Control Facility for treatment of collected wastewater from the Pleasant Bay area in Harwich. There are many details to work out in terms of phasing the use of the Chatham facility which has recently been upgraded and expanded as part of Chatham's wastewater program. Expansion may not need to occur immediately depending on how soon flows from Chatham and Harwich are developed and the return effluent pumping station may be delayed with interim use of recharge capacity in Chatham. Ultimately, effluent recharge for the Harwich flow is expected to occur back in Pleasant Bay with construction of a pumping station to convey the highly treated effluent flow back to Site PB-3. Based on groundwater modeling and preliminary discussions with MassDEP, it is expected that additional treatment for removal of Total Organic Carbon (TOC) will not be required at this site as the time of travel to the nearest municipal well is estimated to be over five years.

The two towns are also working cooperatively to implement the increased flushing of Muddy Creek via widening the existing inlet to 24-ft. Both of these programs will help address the wastewater issues in Pleasant Bay. As the Towns of Brewster and Dennis further develop their wastewater programs other regional opportunities may develop for Harwich which fully supports the concept. At this time there do not appear to be any feasible regional solutions that would impact the Allen, Wychmere or Saquatucket Harbor watersheds which are located solely within Harwich.

Total Maximum Daily Loads (TMDLs) from the Massachusetts Estuaries Project (MEP) issues

The MEP reports for the five watersheds defined in Harwich established the basis for how much nitrogen can be safely discharged to the estuaries and still maintain a healthy environment. The so called TMDL requires significant nitrogen removal in order to be attained as discussed in earlier sections (Section 6 and 8). Ultimately, those TMDLs will become watershed permits enforced by appropriate regulatory agencies in which the Town will need to take action to meet those load limits. This phasing plan will need to take that into account even though at this time there is no mandatory timeline that has been issued. Therefore, it is in the Town's best interest to propose a timeline that meets their various needs but also focuses on meeting the nitrogen removal requirements within the watersheds. Thus, meeting the TMDLs is a significant driver in defining the phasing plan. The Allen, Wychmere, and Saquatucket Harbor watersheds require the highest percentage of nitrogen removal within their watersheds (70 to 100%) even though these watersheds are smaller than the other two.

However, proposed effluent recharge which has some nitrogen loading attached to it needs to be addressed as well since the two recharge sites are located in the Pleasant Bay and Herring River watersheds. Therefore, an appropriate amount of sewering needs to take place in any watershed where recharge is to occur in order to maintain a no net increase in nitrogen balance within that watershed.

Program Costs

As discussed above, the collection and treatment cost is estimated to be about $225 million (plus an additional $5 million for natural attenuation and pond restoration projects). This is a significant program for the Town to undertake. Thus, it needs to be implemented over many years so that as other municipally bonded projects are paid off this program can move forward in a way that tries to minimize the financial impact. The number of phases proposed to implement the program must be weighed versus the need to meet the TMDLs. Initially an eight phase program for implementation is proposed with each phase being approximately five years in duration or averaging $32 million per phase (phases 2 to 8). The cost per phase will vary depending on the specific infrastructure being built. The ultimate number of phases and timeline is likely to vary as well as adaptive management is likely to result in adjustments to the later phases.

In summary, the program costs and attaining the TMDLs are considered to be the most important factors in developing the phasing plan for the wastewater program. Figure 13-2 shows the amount of septic system nitrogen required to be removed from each of the MEP watersheds as discussed earlier in Section 6. To receive regulatory approval the CWMP must present a wastewater program that conforms to the TMDLs. To receive local community approval the program costs must be deemed to be feasible. Providing infrastructure to assist with desired development and acting in a timely and coordinated manner to take advantage of regionalization are next in importance. Addressing Title 5 issues, freshwater pond issues and drinking water well issues are important but are not key drivers in developing the overall phasing plan.

13.4.2 Wastewater Phasing Program by Phase

Based on the above discussion the proposed phasing program is shown in Figures 13-3 and 13-4. Figure 13-3 shows the areas to be sewered by phase while Figure 13-4 shows the phased areas with the buildout or growth areas highlighted to indicate where growth is projected to occur. Details of the proposed phasing program are described below:

Phase 1

The focus of this phase will be to implement the two natural nitrogen attenuation programs. The first is to fund the construction phase of the Muddy Creek bridge which will increase the existing opening to 24-ft width. This significantly inlet widening will increase the flushing in Muddy Creek and will help restore the ecological habitat. The second program is the evaluation of options to improve the natural attenuation in the Cold Brook former cranberry bog network off Bank Street. The goal is to increase the natural nitrogen attenuation from the existing 35% to 50% by adding ponds where denitrification can occur. The recommended plan developed in the study phase would be constructed in Phase 2. Both of these projects will allow the Town to monitor and confirm water quality improvements in these watersheds and to adjust future programs as needed. This phase will also include the purchase of land for the PB-3 effluent recharge facility and will include implementation of the Hinckleys Pond restoration project.

Phase 2

The focus of this phase will be to design and install sewers in the Pleasant Bay watershed since this is the largest watershed with the highest percentage of septic system nitrogen removal required. This also allows the Town to work with Chatham, utilize a regional approach to wastewater treatment and recharge, and to provide further protection to some of the Harwich drinking water supply wells. Phase 2 also provides sewer service to the East Harwich Village Commercial District or East Harwich Village Center and surrounding areas to accommodate potential higher density development. Sewering these areas removes significant nitrogen towards meeting the Pleasant Bay TMDL. Delaying Pleasant Bay sewer construction in this area until this phase also helps avoid time restrictions on the recent roadway improvements done on state road Route 137. Collected wastewater will be pumped to the Chatham WPCF for treatment. A future upgrade to the facility will be required, but that upgrade can be delayed since the Chatham WPCF will have some additional capacity into the future. Depending on timing between the two communities effluent potentially can be recharged at the Chatham facility site for a few years but ultimately may require an effluent pumping station to be constructed for pumping it back to Harwich for recharge at Site PB-3. The recommended plan for the Cold Brook natural attenuation would also be implemented in this phase.

Phase 3

The focus of this phase will also be the Pleasant Bay watershed to install additional sewers in the area north of the Harwich Village Commercial District. A portion of the collection system area on the west side of the Pleasant Bay Watershed will be delayed until Phase 8 to allow for water quality monitoring and evaluation of the impacts from sewering and the Muddy Creek bridge project. This delay will help to ensure that the extent of the wastewater collection is not over reaching, with respect to the TMDL compliance. This phase may also see the implementation of the potential Seymour Pond restoration project. The design and construction of the delayed (see above) Chatham WPCF expansion will also be completed in this phase.

Phase 4

This phase will be done as two programs. Overall the phase will collect wastewater in the Northeast part of the Herring River watershed. The collected wastewater will be pumped to the new treatment plant to be constructed at Site HR-12 (landfill site) where the treated effluent would be recharged. The SBR treatment plant would initially be constructed for a capacity of about 0.45mgd which would treat collected flows from Phases 4, 5 and 6.

Phase 4A will include the construction of the HR-12 treatment plant. This facility must be constructed and ready to receive wastewater before sewers can be connected in the Herring River Watershed.

Phase 4B will include the construction of the sewers in the Herring River Watershed as described above.

Phase 5

This phase will collect wastewater in the Northwest part of the Herring River watershed and near Site HR-12. The collected wastewater will be pumped to the treatment plant at Site HR-12 where the treated effluent would be recharged.

Phase 6

This phase will collect wastewater in the Southeast part of the Herring River watershed. This phase will also install some of the planned sewers in the Allen and Wychmere Harbor watersheds in order to begin meeting the TMDLs in those areas. Collected wastewater will be pumped to the HR-12 site for treatment and recharge. The extent of the collection system constructed in this phase will be coordinated based on the capacity of the existing facility and its ability to accept additional wastewater flow from the homes and businesses served. This phase may also include implementation of the potential Bucks and John Joseph Pond restoration projects.

Phase 7

The focus of this phase will be to expand the HR-12 treatment plant and install the remaining required sewers in the Herring River watershed to meet the TMDL. The treatment plant at Site HR-12 will be expanded to the full 0.9 mgd capacity in this phase. Collected wastewater flows from the southwest area of the Herring River watershed will be pumped to the treatment and effluent recharge facility at Site HR-12.

Phase 8

The focus of this phase will be to install sewers in the Saquatucket watershed and the remaining areas of the Pleasant Bay watershed required to meet those TMDLs. Areas to be sewered near the Great Sand Lakes and the Campground will also be included in this phase. Collected wastewater from the Pleasant Bay area will be added to the flows pumped to the Chatham wastewater treatment facility and effluent recharged in Chatham or pumped back to Harwich for recharge as needed. Wastewater collected from the areas outside of the Pleasant Bay will be treated and recharged at HR-12.

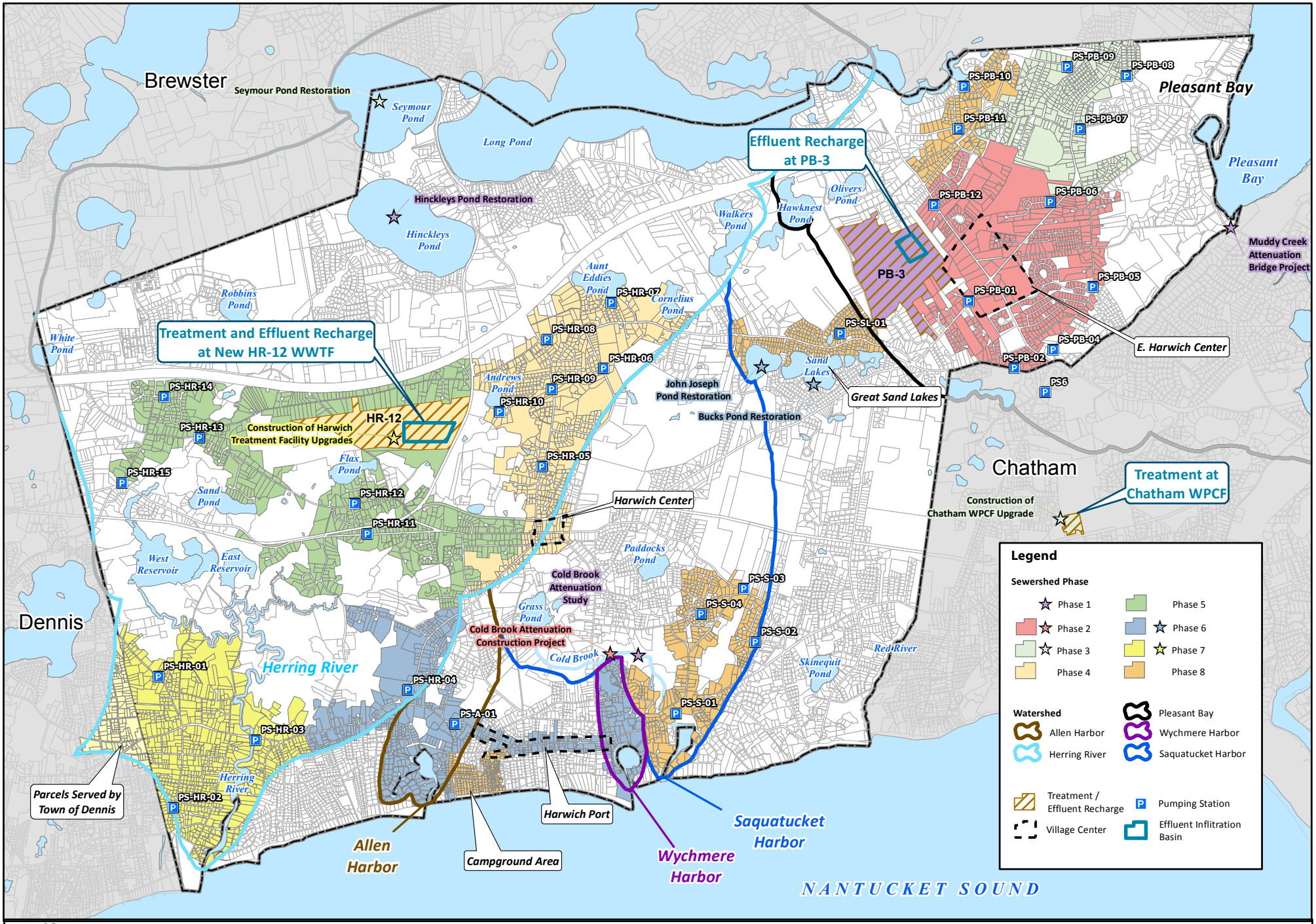
Flow from the Great Sand Lakes area is currently programmed to go with the Pleasant Bay wastewater flows to Chatham but could be switched and conveyed to Site HR-12 for treatment and recharge.

Sewer service areas in Phases 5, 6, 7 and 8 can be adjusted as needed to meet local needs and based on feedback from water quality monitoring. The order in which these phases are implemented is also flexible and can be adjusted to meet those same needs. For instance areas along Route 28 may want to be sewered earlier than proposed to meet potential economic development needs or to help protect the Allens Harbor which is in the process of being dredged.

Table 13-11 below presents each phase of the wastewater plan, the estimated number of parcels served and the estimated buildout annual average day flow (wastewater and I/I) for each phase.

Table 13-11
Wastewater Flows by Phase

Phase	Number of Parcels Served	Build-out Annual Average Wastewater Use – With I/I (GPD)
1	0	0
2	600	153,000
3	440	112,000
4	700	178,000
5	730	186,000
6	650	165,000
7	760	193,000
8	1,066	270,000
Total (Rounded)	**4,950**	**1,257,000**



Sewer Service Area by Phase

1 inch = 4,000 feet

0 1,000 2,000 4,000 Feet

Figure 13-3
Recommended Phasing Plan

CDM Smith

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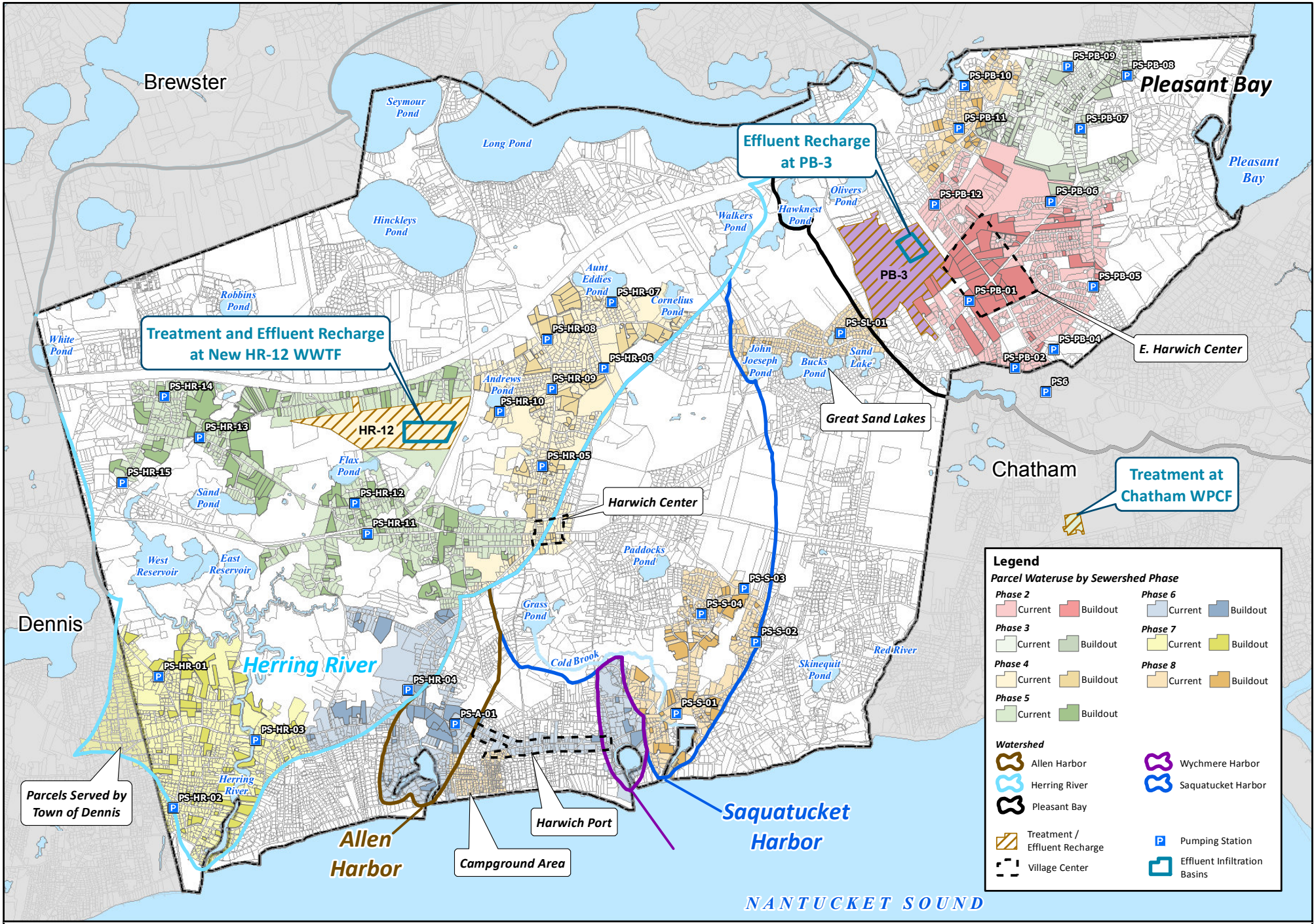

N

Sewer Service Area by Phase
Existing and Buildout Parcels

1 inch = 4,000 feet
0 1,000 2,000 4,000 Feet

Figure 13-4
Recommended Phasing Plan
Buildout Parcels

CDM Smith

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As discussed in Section 13.2.5, the MEP developed buildout flow projections without changing the number of parcels in their GIS layer. As a result, the number of parcels in the recommended plan does not change from present day to buildout conditions. If the Town develops a cost recovery strategy based on the number of parcels within the wastewater service area, it will need to develop an updated map/lot database to reflect additional property subdivisions that are expected under buildout conditions.

13.4.3 Wastewater Phasing Plan Costs by Phase

Based on the updated information provided in this CWMP, preliminary project costs have been updated for the recommended plan by phase and are summarized below in Table 13-12. This table builds on the $225 Million cost presented in Table 13-10 and adds $5.1 Million for natural attenuation and pond restoration projects.

Table 13-12
Details of Phasing Plan Costs by Phases 1-8

Phase	Collection System	Treatment Facility	Design and Permitting Allowance	Natural Attenuation and Pond Restoration Projects	Total
1	$0	$230,000	$25,000	$2,300,000	$2,550,000
2	$18,800,000	$0	$3,500,000	$2,000,000	$24,300,000
3	$12,600,000	$7,300,000	$810,000	$300,000	$21,010,000
4	$20,000,000	$31,000,000	$5,700,000	$0	$56,700,000
5	$20,900,000	$0	$2,300,000	$0	$23,200,000
6	$18,600,000	$0	$2,100,000	$500,000	$21,200,000
7	$21,800,000	$20,700,000	$4,700,000	$0	$47,200,000
8	$30,500,000	$0	$3,400,000	$0	$33,900,000
Total	**$143,200,000**	**$59,230,000**	**$22,535,000**	**$5,100,000**	**$230,060,000**

These project costs include general construction, bidding, and engineering design, permitting and support during construction and contingencies. These costs are projected ahead to April 2013 (ENR index 9475). Costs for design and permitting of the next phase are shown in the phase prior to the construction phase.

The phasing of this plan is between $2.6 to $47.2 million for each phase of the program - for a total of $230 million. This includes an additional allowance of $3.8 million for the Muddy Creek and Cold Brook attenuation projects and includes $1.3 Million allowance for the study and restoration of Hinckleys Pond, Seymour Pond, Bucks Pond and John Joseph Pond. The initial HR-12 treatment facility will be built in Phase 4 and is proportionally more costly in the initial phase as it includes all the supporting buildings and common processes. It is proposed that this facility will be upgraded to accommodate the additional wastewater flow and increased treatment capacity in Phase 7. The expansion is mainly for treatment processes and tankage expansion. The existing wastewater flow from Phases 4 to 6 will need to be verified that it is within the initial treatment plant capacity and that buildout flows have not occurred. The adaptive management approach will allow the treatment facility expansion requirements and sewer service areas to be further evaluated and modified as needed between Phases 4 and 7.

13.4.4 MEP issues related to wastewater phasing

As described in Section 6, the MEP reports for the Allen, Wychmere, Saquatucket, Pleasant Bay, and Herring River watersheds describe the development of target nitrogen loads to meet the goals established for restoration of eelgrass and/or infaunal habitats in each embayment. Figure 13-2 summarizes what was shown in Table 6-10. As shown 58% to 100% of septic system nitrogen loading needs to be eliminated in order to meet the water quality goals in the five watersheds, if only focusing on nitrogen reduction from septic system loads. The reports note that these are attenuated loads, accounting for travel through the watershed prior to reaching the embayment.

In the MEP reports, there is a discussion on the possibility of increasing the inlet opening to the Muddy Creek in order to increase tidal flushing to the creek. The report suggests that if the inlet modifications are made, a 20% drop in the difference between the existing conditions modeled and the threshold concentration at the lower Muddy Creek check station will be realized. This change is significant and thus the Town decided to move forward with the assumption that the addition of a 24-foot opening at the head of the Muddy Creek will be implemented as part of the overall wastewater management program.

The proposed sewering plan involves removing more than 58% of the septic systems from the Allen, Wychmere, Saquatucket, Pleasant Bay, and Herring River watersheds over the course of the sewer installation phases. The proposed wastewater treatment plant and associated groundwater recharge sites are located within the Herring River and the Pleasant Bay watersheds, so the nitrogen load from the treated effluent discharged to the ground on the proposed recharge sites will be considered a new input to the watershed.

Since the Herring River Watershed will receive the majority of the effluent recharge flow, it is important to insure that the phasing of the wastewater treatment system (and associated effluent recharge) does not result in a net increase in nitrogen to any watershed.

In the Allen, Wychmere, and Saquatucket watersheds, all of the corresponding nitrogen will be removed from the watershed. The ability to meet the MEP goals for these watersheds will depend on the amount of septic nitrogen removed from them. In the Herring River and the Pleasant Bay watersheds, however, the ability to meet the MEP goals will depend on the corresponding nitrogen removed and the effluent recharge introduced back into the watershed. This nitrogen balancing is critical to the success of the program. For the program to be successful, the Town must demonstrate that the wastewater system phasing plan does not result in an increase in nitrogen to any watershed. The only acceptable scenario, from a regulatory point of view, will utilize a phasing plan that gradually decreases the nitrogen load to the watershed until the threshold load is achieved. This reduction must take place without increasing the load over present day values. In order for this to happen, the first phase of the wastewater plan must remove nitrogen from the watershed(s) that will receive effluent recharge. The proposed phasing plan achieves that goal.

13.4.5 Effluent Recharge Related to Wastewater Phasing

Phase 1

No effluent will be recharged in this phase however water quality monitoring of the natural nitrogen attenuation programs should occur to confirm assumptions utilized herein.

Phases 2 and 3

The effluent recharge for these phases will utilize open infiltration basins at either the Chatham facility or the PB-3 site to handle all of the Phase 2&3 flow. Ultimately, all of the flow may have to be shifted to the PB-3 site for effluent recharge. These phases address most of the service area in the Pleasant Bay watershed and will leave the Great Sand Lakes area for a later phase. A small part of the Pleasant bay service area will be delayed until Phase 8 to allow additional study of the Muddy Creek project that is expected to reduce the need for sewers while achieving the TMDL.

Phases 4, 5 and 6

The effluent recharge for these phases will utilize open infiltration basins at the HR-12 site to handle the flow from the Herring River. A Permeable Reactive Barrier (PRB) pilot program will be conducted at Site HR-12 during Phase 4 in order to determine its applicability in future phases.

Phase 7

The effluent recharge for this phase will continue to utilize open infiltration basins at the HR-12 site and will handle the full service area in the Herring River watershed.

Phase 8

The effluent recharge for this phase will utilize open infiltration basins at the HR-12 site. This phase will handle the full service area in the Saquatucket watershed and the Campground area. The Great Sand Lakes area can be recharged at PB-3 or HR-12 depending on where it is ultimately treated. This phase will also utilize the PB-3 site (if Chatham recharge is not available) for the remaining wastewater collection area in the Pleasant Bay if it is needed.

This phasing plan was developed so that the service area in the Herring River and the Pleasant Bay watersheds will ensure that the total nitrogen loading to each nitrogen sensitive watershed does not increase above present day levels. As the phasing plan progresses, the net nitrogen load in these two watersheds will gradually decrease until the recommended plan is complete. At that time all of the nitrogen sensitive watersheds will be in compliance with the TMDL's.

It is recommended that the Town coordinate with the Monomoy School Department in order to maintain access to potentially using Site SH-2 for effluent recharge only in the future in case impacts to the watersheds as estimated in this plan need to be revised or additional sewering is required resulting in the need for more recharge capacity. This site is in a third watershed which would beneficially spread the effluent recharge to another watershed and the site is upgradient of the Cold Brook natural nitrogen attenuation area.

13.5 Natural Attenuation Projects Cold Brook and Muddy Creek

Since natural attenuation of nitrogen is part of a natural freshwater system, the Allen, Saquatucket, Pleasant Bay and Herring River watershed systems all have some degree of natural attenuation associated with them. In the Allen Harbor watershed, the Allen Harbor stream is estimated to have approximately 30 percent nitrogen attenuation. In the Saquatucket Harbor watershed, attenuation occurs in several ponds and streams including the Cold Brook. The Pleasant Bay system has natural attenuation in several ponds as well as the Muddy Creek system. For the purposes of the wastewater

scenarios, the existing natural attenuation factors are accounted for in the MEP nitrogen models and are considered to be existing conditions because they approximate actual field conditions as reported by the MEP.

The Town, however, also has the ability to initiate two projects that will enhance the existing natural attenuation in the Saquatucket Harbor watershed and at Muddy Creek in the Pleasant Bay watershed. The end result of implementing these projects is a cost-effective reduction in the total amount of sewering required in both the Saquatucket Harbor and Pleasant Bay watersheds while still meeting the MEP established TMDL requirements for nitrogen removal.

To realize the benefits of these two projects, the Town developed the recommended wastewater plan based on the assumption that they will enhance the natural attenuation in the Saquatucket and Pleasant Bay watersheds by constructing both the Cold Brook project and the Pleasant Bay tidal flushing project. The result is this recommended plan relies on educated assumptions about the potential beneficial impacts of the two projects. Once these projects are completed and the results of the improvements can be measured, then regular water quality sampling (See Adaptive Management Program (AMP)) will allow the Town to assess the true impacts of the project. After evaluation of that data the Town can adapt the recommended plan and adjust the sewer service areas to meet the TMDL and keep the wastewater collection area as small as possible.

The costs for these two projects are presented in Table 13-12. At this time the Town is pursuing multiple avenues for funding. Both projects are considered significant components of the recommended plan as they offset sewering in a cost-effective manner.

13.5.1 Saquatucket Natural Attenuation Project (Cold Brook)

The June 2010 final Linked Watershed Embayment Model presented in the MEP report for the Allen, Wychmere and Saquatucket Embayment Systems presents an alternative scenario that changes the attenuation rate in the Cold Brook from the existing 35% to 50%. Further analysis by the Town indicated that this change in attenuation is significant and would result in a reduction of the sewer service area while still meting the TMDL.

For the Town to implement this project, additional study is needed, but the MEP modelers generally agree that the Cold Brook can be enhanced to increase the residence time of freshwater flowing through the system by creating depositional basins (ponds) after determining specific sites within the bog system to increase the nitrogen removal. Preliminary discussions with the Harwich Conservation Trust who owns the land in this area has begun and future study efforts will be coordinated with them.

Additional nitrogen reductions are still required in the Saquatucket Harbor watershed to meet the threshold concentration in the harbor, but the magnitude is reduced because of the enhanced attenuation expected in the Cold Brook. This modification is expected to result in the 50 percent attenuation mentioned above and is expected to roughly save $6 million in collection system only costs at $25,000 per lot.

13.5.2 Pleasant Bay Natural Attenuation Project (Muddy Creek)

An MEP technical memorandum evaluated the water quality impacts of the addition of a 24-foot wide culvert in the Muddy Creek inlet. In this memorandum an alternative scenario is presented to the May 2006 final Linked Watershed Embayment Model for the Pleasant Bay system and presents an alternative scenario that reduces the threshold nitrogen concentrations in the upper and lower Muddy Creek sub-embayments as a result of increased flushing with the wider inlet. For the Town to implement this project, the two 4-foot existing culverts would need to be increased in size to at least a 24-foot opening. The modeling that was performed for the Pleasant Bay system showed that replacing the existing inlet is expected to result in a 20% drop in the difference between the existing conditions modeled and the threshold concentration at the Lower Muddy Creek check station. Additional nitrogen reductions are still required in the Muddy Creek watershed to meet the threshold concentration in Lower Muddy Creek, but the magnitude is reduced through the installation of the wider culvert. This modification is expected to roughly save $5.7 million in collection only system costs at $25,000 per lot.

The Town and Chatham are working collaboratively to construct the new culvert in the Muddy Creek and have appropriated funds for the design of the project. Once the design is complete, both towns will seek the appropriate funding required to construct the project.

13.6 Recommended Cost Recovery Plan

The plan phasing is between $2.6 to $47.2 million for each phase of the program, for a total of $180 to $230 million. This total includes an additional allowance of $3.8 million for the Muddy Creek and Cold Brook attenuation projects and includes $1.3 million allowance for the study and restoration of Hinckleys Pond, Seymour Pond, Bucks Pond and John Joseph Pond. The initial HR-12 treatment facility will be built in Phase 4 and is proportionally more costly in its initial phase as it includes all the supporting buildings and common processes. It is proposed that this facility will be upgraded to accommodate the additional wastewater flow and increased treatment capacity in Phase 7. The adaptive management approach will allow the treatment facility expansion requirements and sewer service areas to be further evaluated and modified as needed between Phases 4 and 7. Annual operation and maintenance costs at buildout are projected to about $3.0 million annually.

Harwich's Wastewater Implementation Advisory Committee (WIAC) is in the process of eva-luating various cost recovery models. The WIAC is considering using a combination of methods including betterments, user fees, and the general tax base to pay for the multi-phase construction project and is currently discussing all of the options that can be implemented in a cost recovery program. Their goal is to not negatively impact any one Harwich area or residential group as they realize everyone in Town contributes to the nitrogen issue one way or another. Once the WIAC decides on a cost recovery model that it determines is fair and feasible, a recommended plan will be presented to the Board of Selectmen for review, modification and approval. The WIAC recommendation is targeted for June 2013 and that proposed program will be presented in the Final CWMP.

In the meantime Table 13-13 has been presented to the Capital Outlay Committee and it is based on the phasing plan discussed earlier.

Table 13-13
Details of Phasing Plan Costs by Phases 1-8

Capital Outlay Committee - Requirements for CWMP		
2013 Funding Request	**Phase 1**	**Total = $2,550,000**
1	$250,000	For PB-3 Recharge Facility Land Purchase
2	$500,000	For Hinckleys Pond Restoration
3	$100,000	For Cold Brook Attenuation Study
4	$1,700,000	For Muddy Creek Attenuation Bridge Project
2016 Funding Request	**Phase 2**	**Total = $24,300,000**
1	$22,300,000	For Design and Construction of Pleasant Bay Collection System (South)
2	$2,000,000	For Cold Brook Attenuation Construction Project
2021 Funding Request	**Phase 3**	**Total = $21,010,000**
1	$12,600,000	For Construction of Pleasant Bay Collection System (North)
2	$8,110,000	For Design and Construction of Chatham WPCF Upgrade
3	$300,000	For Seymour Pond Restoration
2026 Funding Request	**Phase 4A**	**Total = $34,400,000**
1	$34,400,000	For Design and Construction of Harwich Treatment Facility HR-12
2029 Funding Request	**Phase 4B**	**Total = $22,300,000**
1	$22,300,000	Design and Construction of Herring River Collection System (Northeast)
2033 Funding Request	**Phase 5**	**Total = $23,200,000**
1	$23,200,000	For Design and Construction of Herring River Collection System (Northwest)
2038 Funding Request	**Phase 6**	**Total = $21,200,000**
1	$20,700,000	For Design and Construction of AWS and Herring River (SE) Collection Systems
2	$250,000	For Bucks Pond Restoration
3	$250,000	For John Joseph Pond Restoration
2043 Funding Request	**Phase 7**	**Total = $47,200,000**
1	$26,500,000	For Design of Harwich WWTF Upgrade and Design and Construction of Herring River Collection System (Southwest)
2	$20,700,000	For Construction of Harwich Treatment Facility Upgrade
2048 Funding Request	**Phase 8**	**Total = $33,900,000**
1	$33,900,000	For Design and Construction of Campground Area, GSL and Final PB Area to Meet TMDL
Total Funding Request	**Phases 1-8**	**Total (rounded) = $230,000,000**

Based on discussions with Harwich representatives the 40 year implementation has been divided into the timeline as shown in Table 13-14. The town will need to further evaluate and potentially adjust this timeline to help coordinate financing of other large capital project in town in order to minimize financing impacts.

Table 13-14
Timeline for Phasing Plan Costs by Phases 1-8

Phase	Calendar Year	Duration (years)	Amount
1	2013 to 2015	3	$2,550,000
2	2016 to 2020	5	$24,300,000
3	2021 to 2025	5	$21,010,000
4A	2026 to 2028	3	$34,400,000
4B	2029 to 2032	4	$22,300,000
5	2033 to 2037	5	$23,200,000
6	2038 to 2042	5	$21,200,000
7	2043 to 2047	5	$47,200,000
8	2048 to 2052	5	$33,900,000
Total Program	**2013 to 2052**	**40**	**$180 Million to $230 Million**

The overall program to meet the nitrogen TMDLs and the other defined town needs is estimated to be $230 Million. However, the recommended program includes a buildout growth of about 26% which is a prudent projection but may not occur. It also does not take credit for any other non-infrastructure nitrogen reduction aspects of the program such as fertilizer reduction, improved stormwater controls and land use changes. Thus, if only half the growth occurred and up to half of the nitrogen contributions from fertilizer and stormwater were achieved then it is conceivable that a 25% reduction in the recommended infrastructure could be realized resulting in a program cost of about $180 Million.

13.7 Other Recommended Program Components

The subsections above describe mainly infrastructure related components of the recommended wastewater management plan. However, there are several non-infrastructure related components that need to be implemented as well and they are described below.

13.7.1 Public Outreach

Public participation and outreach has been a priority during the CWMP process, starting in 2007 when informational public meetings were initiated to gain participation and feedback from residents and business owners. Several participants at those meetings included the Wastewater Management Subcommittee (WMS), Water Quality Management Task Force (WQMTF), Citizens Advisory Committee (CAC), Planning Board members, representatives from the Cape Cod Commission (CCC), and other representative members of the community, including town staff advisors and selectmen. Additional educational opportunities have been provided by CWMP partners including MEP and the Coastal Systems Program at the UMass Dartmouth School for Marine Science and Technology (SMAST) and the Department of Environmental Protection (MassDEP) The public outreach program to date has

focused on educating the public about the need to address nutrient pollution issues and informing residents about the ongoing wastewater program planning, the MEP and TMDL processes, the nitrogen removal technologies available, and how wastewater planning will affect the overall community. Ultimately this valuable input was utilized to develop the recommended wastewater program described herein.

Harwich will continue to offer public outreach and educational opportunities through these collaborations during the implementation of the CWMP recommendations. This will be particularly important during construction phases so that residents and business owners understand what is happening and when it will happen. Additional outreach efforts will include information about proper fertilizer application, low impact landscaping techniques, and water conservation practices. Programs will be designed to complement the needs of the community and will prioritize total nitrogen reduction through proven best management practices. Additional consideration will be given to developing nutrient management website resources on the Harwich website, printed educational materials, and participation in community events.

13.7.2 Fertilizer Education

Fertilizer applied to golf courses, agriculture, town properties and residential lawns are estimated to account for approximately 7 to 13 percent of the total controllable nitrogen load to the estuaries. While the recommended wastewater management plan focuses on reduction of septic system nitrogen which is the largest component of the controllable nitrogen load in a watershed, fertilizers will continue to affect local estuaries until steps are taken by residents, landscapers, golf courses, and cranberry bogs to reduce overall fertilizer use. Educational programs have been initiated primarily through the Pleasant Bay Alliance, which Harwich is a member. Harwich's Conservation Commission has also actively enforced protection of buffer zones to minimize fertilizer movement to water bodies.

The fertilizer education program will focus on ideal application types and rates of fertilizer and on awareness of the negative effects of over-fertilization or inappropriate use. The program will also target portions of Harwich located upstream from the most sensitive water sources and may include website resources, handout materials, collaboration with local landscaping companies, and other regional and County initiatives for the benefit of the community.

Harwich will also continue to participate in initiatives related to the Pleasant Bay Alliance Fertilizer Management Plan, which was proposed in December 2010. The management plan introduced six strategies to reduce nitrogen input from fertilizer use in the Pleasant Bay watershed:

1. Limit fertilizer use on municipal properties, such as athletic fields and parks.

2. Minimize fertilizer application on golf courses.

3. Enforce 50-foot buffer “no fertilization” zone around sensitive surface water resources and restore wetland buffers.

4. Provide outreach and education for a variety of property owners and property managers to encourage fertilizer best management practices.

5. Offer training for turf grass managers to encourage low-nitrogen landscaping practices.

6. Develop regulations which reduce lawn size in future development projects.

The Town will take each of the strategies into consideration and develop local outreach programs and/or practices, as needed, to address fertilizer contributions in sensitive watershed areas.

13.7.3 Stormwater BMP's

Stormwater from runoff and impervious surfaces is similar to fertilizer in terms of the amount of total controllable nitrogen load to the estuaries. It can also be a source of nutrients to the fresh water resources in Harwich. While wastewater planning will reduce pollutants, stormwater will continue to affect local water bodies. Steps will continue to be taken by the public works de-partment to enact stormwater best management practices (BMPs) that help reduce the turbidity from stormwater and reduce the total pollutant (phosphorus, nitrogen and pathogens) load to both the fresh and salt water resources in Harwich.

All three of the above non infrastructure components should be addressed on a continuing basis however combined they do not achieve the required nitrogen reduction required to meet the estu-ary TMDLs. It is also difficult to monitor the longterm benefits of each component. Improved fertilizer management and stormwate rmanagement will result in improved water quality which will be observed via longterm water quality monitoring. That benefit will allow the Town to im-plement the wastewater program closer to the lower end cost range.

The stormwater BMP program will focus on ideal application of BMPs at the drain features throughout Harwich. The program will target those portions of town located upstream from the most sensitive water sources and will include several stormwater controls and / or practices on all new work. As the program is developed, the town will decide which types of controls are most appropriate.

Listed below are five common Best Management Practice strategies to reduce pollutant input to the local water resources:

1. **Deep Sump Drainage Basins**

   Deep sump catch basins are modified versions of the inlet structures typically installed in a piped stormwater conveyance system. They provide capacity for sediment accumulation.

2. **Detention Pond Infiltration Basins**

   Detention pond infiltration basins are used to manage stormwater runoff, and improve water quality in adjacent water bodies. These are shallow artificial ponds designed to infiltrate stormwater into the ground versus direct discharge to a water body.

3. **Utilize Porous Pavement**

   Porous pavement is a permeable pavement surface with a stone reservoir underneath. Runoff from porous pavement infiltrates directly into the soil and receives some level of filtration and therefore receives minimal water quality treatment. Porous pavement looks the same as traditional asphalt or concrete but is manufactured without "fine" materials, and instead incorporates void spaces that allow for infiltration.

4. Utilize Bio – Retention and Vegetated Basins

Bio retention basins utilize structures to physically remove contaminants and sediment from stormwater runoff. Stormwater is collected into the treatment area which consists of a ponding area. Runoff passes first over or through the ponding area which slows the runoff's velocity and distributes it evenly along the length of the basin. The vegetated basins allow pollutants to settle and filter out, and also provide the opportunity for the uptake of nutrients. A vegetated infiltration basin can also help fulfill site landscaping requirements.

5. Catch Basin Cleaning Basins

According to the USEPA, catch basin cleaning is an efficient and cost effective method for preventing the transport of sediment and pollutants to receiving water bodies. This improves both aesthetics and the quality of the receiving water body. Catch basins should be inspected regularly to determine if they need to be cleaned.

Harwich will consider these strategies and others and develop an appropriate town-wide BMP strategy to initially implement in the most sensitive watershed areas, and eventually throughout the entire town.

13.7.4 Freshwater Ponds Evaluation, Sampling and Restoration

In Section 5 of this CWMP, the health of the Harwich freshwater ponds was evaluated and summarized. According to the Cape Cod Pond and Lake Atlas (CCC, 2003), the Town has 63 ponds with a total area of 850 acres. The Cape Cod Pond and Lake Stewardship (PALS) program has consistently sampled up to seventeen locations annually in sixteen of Harwich's ponds, typically in July, August, and/or September. Data from the PALS sampling program for 2006-2010 were reviewed for that analysis.

The sixteen Harwich ponds in this pond health assessment are quite diverse in both physical and water quality characteristics. Harwich's ponds provide important habitat for aquatic life and are important natural resources for the community. The growing number of pond restoration actions on Cape Cod suggests that many ponds are reaching their tipping points, where further alterations to the environment will result in sometimes dramatic changes in water quality. These have included noxious and potentially harmful algal blooms at Hinckleys Pond and Skinequit Pond. Below are some preliminary steps that should be taken to protect or restore Harwich's ponds.

1. Continue sampling

It is recommended that sampling of all current ponds continue. It is also recommended to expand the PALS program to collect at least one sample annually from other Harwich ponds without historic water quality data so that a baseline can be established.

2. Perform an inventory of all stormwater pipes draining to ponds

Road runoff as a potential source of contamination was identified in at least twelve ponds. Create an inventory incrementally with focus on ponds with water quality data. If found, divert or disconnect stormwater systems that directly discharge to ponds.

3. Investigate other potential contaminant sources

Phosphorus loads from the following sources should be considered: abandoned or active cranberry bogs, sediment dumping locations, farms, private impervious surface runoff, private landscape and fertilizer applications, and waterfowl. Decreasing phosphorus loads to ponds that are currently affected by high phosphorus concentrations would improve pond health. For ponds that have evidence of phosphorus regeneration, expansion of monitoring points allows for a more accurate understanding of phosphorus regeneration.

4. Determine uses and ponds to support

Fostering stakeholder and public participation is a key component in determining which ponds and which uses for each individual pond should be prioritized to keep or meet a high quality designation. An example would be to prioritize the protection of Olivers, Hawksnest, and Black Pond to prevent water quality degradation from affecting fish populations, if that is a priority for the community. Table 13-15 summarizes the analysis and recommendations for each of the sixteen ponds currently sampled and examined.

Table 13-15
Harwich Ponds Health Assessment Summary and Recommendations

Name	Pond Trophic Status	Monitor	Investigate Road Runoff Contribution	Investigate Potential Contaminant Sources	Shoreline Development
Andrews Pond	Oligotrophic	X		X	Low
Aunt Edies Pond	Mesotrophic	X	X	X	Low
Bucks Pond	Oligo-mesotrophic	X	X	X	Medium to High
Cornelius Pond	Eutrophic	X		X	Low
Flax Pond	Oligo-mesotrophic	X	X	X	Low
Grass Pond	Meso-eutrophic	X	X	X	Low
Hawksnest Pond	Oligotrophic	X	X	X	Low
Hinckleys Pond	Eutrophic	X	X	X	Medium to High
Island Pond	*	X			*
John Joseph Pond	Mesotrophic	X	X	X	Medium to High
Littlefields Pond	*	X			*
Long Pond	Mesotrophic	X	X	X	Medium to High
Oilvers Pond	*	X			*
Okers Pond	*	X			*
Paddocks Pond	*	X			*
Robbins Pond	Mesotrophic	X		X	Low
Sand Pond	Mesotrophic	X	X	X	Low
Seymour Pond	Mesotrophic	X	X	X	Medium to High
Skinequit Pond	Eutrophic	X	X	X	Medium to High
Walkers Pond	Mesotrophic	X	X	X	Low
West Resevior	*	X			*
White Pond	Oligo-mesotrophic	X		X	Low

Note: (*) Data not provided

The highlighted ponds in Table 13-15 should be examined more closely to determine the sources of phosphorus. The Town recently conducted an analysis of Hinckleys Pond (CDM Smith/WRS July 2012) and had previously done phosphorus inactivation in Long Pond. The Skinequit Pond Association has taken steps to improve water quality in their pond. Water quality studies should be done for Seymour Pond, Bucks Pond and John Joseph Pond to start. Actions plans to address phosphorus reduction near them should be developed. If adding sewers within their watersheds and thus removing septic system effluent phosphorus inputs would be appropriate to reduce degradation then it can be handled through an adaptive management approach during the implementation phase of the CWMP recommended program.

13.7.5 Continued Salt Water Sampling

Now that the MEP water quality monitoring program is complete, the Town via the WQMTF oversight will continue monitoring water quality at the defined sentinel and check stations. Monitoring of each sentinel and check station within Harwich is proposed seasonally for the duration of the implementation phase. At this time, it is anticipated that regular sampling required by the future groundwater discharge permits will ensure that the health of the local estuaries improves as the program moves forward. As the program nears completion and is in the final phases, the sampling will become more important because the results may indicate, through adaptive management, that the extent of the sewer service areas can be reduced. The result could be a significant cost savings to the Town. This approach will be most important in the Pleasant Bay and Saquatucket watersheds where the two attenuation projects (Muddy Creek and Cold Brook) are to be implemented.

13.7.6 Low Impact Landscaping

As part of the nutrient management programs, the Town will encourage low impact landscaping. Low impact landscaping encourages the use of plantings that minimize the need for watering as well as the use of fertilizers. By utilizing these low impact plantings and reducing lawn areas, the maintenance can actually be reduced while minimizing environmental impacts to the watershed.

13.7.7 Water Conservation Programs

Increased water use introduces a pathway for nitrogen to enter sensitive estuaries. Water conservation is a cost effective and environmentally sound way to reduce the demand for water, which is particularly important during warm weather months when overall water use increases by about 50 percent. The Water Department has a by-law which limits outdoor water usage and maintains educational signage throughout the Town to remind residents of the rule. Further reductions in water use may be found through an education and outreach program which focuses on the benefits of water efficiencies.

Examples of residential and commercial water efficiencies include incorporating low flow plumbing fixtures such as faucets, shower heads, hoses, and toilets. Efficiencies can also be found in landscaping by utilizing native plants and grasses whenever possible, watering lawns and landscaping as-needed and for limited amounts of time, installing rain sensors into irrigation systems, maintaining pools to eliminate leaking, mulching around plants to insulate from evaporation, maintaining leaky faucets and drains, and planning landscaped areas according to sun and water demand.

In addition to reducing nitrogen pathways, saving water also saves energy. Almost 90 percent of residents in Harwich receive water from eleven groundwater wells located throughout the Town.

Reducing overall water consumption will also reduce the amount of energy necessary to pump, filter, and treat water and that reduction will save costs.

The Harwich Water Department currently maintains a comprehensive list of resources related to water conservation, including several guidelines on consumer water conservation practices and preventing water waste. Through implementation of the CWMP, the program could be expanded to include participation in community events, k-12 educational presentations, developing and/or distributing paper materials and fliers in a general campaign and a focused effort that targets the highest nitrogen-producing areas of the community.

13.7.8 Inflow Prevention Programs

An inflow prevention program will be implemented as soon as the first wastewater customers are tied into the new sewer system. Inflow prevention programs seek to ensure that water from street drains, sump pumps, driveway drains or any other clean water sources do not make their way into the wastewater collection system. When inflow sources are introduced into the wastewater collection system, the wastewater treatment facility is burdened with treating this extra flow. Unfortunately, these sources of inflow do not need to be treated at the wastewater facility. The result is an unnecessary burden on the collection system, pumping stations and effluent recharge facilities. This burden costs additional dollars in the form of maintenance and the cost of pumping and treating this extra flow. By implementing an inflow program from the very beginning, the Town can educate the public, monitor its system and minimize the amount of inflow to the collection system.

13.7.9 On-site System Support

The staff at the Harwich Health department has several resources dedicated to the maintenance of septic systems and septic system maintenance. The Towns website (http://harwichma.virtualtownhall.net/Public_Documents/HarwichMA_Health/Septic%20Systems%20and%20Title%205) lists several resources that a homeowner can utilize when selling their property or siting a new septic system. The website also gives guidelines on how to best maintain an existing septic system.

Even after the wastewater program is fully implemented, there will still be a significant amount of Title 5 septic systems functioning in Harwich. The health department will continue its efforts in supporting owners of these systems and will continue to oversee their operation.

Several resources listed on the website include:

- Real Estate Transfers (Regulations, Inspection Addendum, Waiver form)
- List of local Engineers, Sanitarians, and Title 5 Inspectors
- Massachusetts Title 5 Inspection Forms
- Town Title 5 Inspection Addendum Form
- Sewage Disposal Permit Instructions
- List of Septic Installers licensed in the Town
- Low interest LOAN Program for failed septic systems (through Barnstable County)

- Sewage Permit Application checklist for Septic Installers
- Installer's License application (annual renewal)
- Trench Permit (test holes)
- Permit Fees

As part of the wastewater program, the Town will continue to regularly notify the property owners who remain on conventional septic systems of the importance of regular maintenance.

13.7.10 School Education Programs

The Town will initiate a school education program for primary and secondary aged school children geared toward better understanding of the recommended wastewater program. The program will introduce the concept that water is a precious resource that must be protected and will be dedicated to educating both students and the community about the environmental and economic benefits of using water efficiently. Understanding the full water cycle (water, wastewater, stormwater, etc.) and that water is a valuable resource is an important concept for all to know.

13.7.11 Board of Health Regulatory Review

The Harwich Board of Health will continue to develop appropriate regulations and bylaws to meet the Town goals and to keep wastewater growth within the projected buildout as required by the SRF loan program for zero interest loans. They will coordinate this process with the Planning Board before deciding whether Health Regulations or zoning regulations are the best approach for Harwich to implement this wastewater flow management requirement.

13.7.12 Innovative and Alternative Technologies Committee

Because of the high costs today of providing proven nitrogen removal treatment technology to the very stringent standards required to meet the proposed TMDLs, there are several innovative and alternative (I/A) technologies being tested. As described earlier, the available I/A technologies do not meet the nitrogen removal requirements or their use was not cost effective. However, development of new technologies should always be monitored and evaluated for incorporation into this recommended wastewater program. The Harwich program has been designed with significant flexibility into it that would allow potential technology improvements to be incorporated if appropriate. Harwich should develop a committee that monitors these systems going forward and work collaboratively with the WQMTF-WMS and the Board of Health.

13.7.13 Land Use

The Town should continue to review land use planning tools for applicability to this recommended program and for meeting other town needs. Continued efforts such as those ongoing in the East Harwich Village Center area and other village centers should occur as they may result in changes to this program. Land use planning tools such as up-sizing of lots via zoning revisions, open space acquisitions and the like would result in lower nitrogen loadings in a given watershed requiring less sewering. Similarly, higher density development or expansion of commercial areas may result in higher nitrogen loadings potentially requiring more sewering. The percentage of growth currently included in each watershed varies significantly as shown in Table 13-1. There are several factors in play in this analysis (economics, open space, growth/ no net growth, utilities, traffic, etc.) but clearly

the Pleasant Bay and Herring River watersheds are the ones where any land use revisions will have the most impact.

13.8 Adaptive Management Plan (AMP)

One benefit of a phased sewering approach is the ability to modify the recommended wastewater program as needed during the implementation phases. This "adaptive management" strategy allows for modification to the phasing, the timing, or the exact areas to be sewered depending on the results of the earlier implementation phases. The phasing plan discussed earlier allows for the adaptive management to be fully utilized if the total sewer service area changes or if new technologies arise that provide better or more cost-effective treatment than those presently proposed. The Town plans to continue revisiting the recommended program throughout its implementation to re-evaluate each phase prior to design and construction. The proposed Adaptive Management Plan (AMP) scope is described below.

13.8.1 Adaptive Management Plan Scope

The AMP associated with Harwich's Recommended Program will have several components to allow for systematic review of the implementation phase and the resulting changes to water quality, community growth, and economic viability. Specifically, the following items are proposed to comprise the AMP:

1. ***Technical Review Committee:*** A technical review committee (TRC) will be established to review the progress of implementing the CWMP Recommended Program and the potential need to modify the plan during the implementation phase. The TRC will include, but not be limited to, representatives from the Town, Chatham, MassDEP, and the CCC. Representatives from other towns may also be involved if they participate in regional solutions with Harwich. The TRC will meet as needed during the implementation phase, but not less than quarterly. The ultimate make-up and authority of the TRC will be determined by the town but the main purpose is to coordinate and monitor the various aspects of the recommended program.

2. ***Water Quality Monitoring:*** Now that the MEP water quality monitoring program is complete, the Town plans to continue monitoring water quality at the sentinel and check stations. Monitoring will move from the detailed sampling program required for the MEP modeling to periodic monitoring to track the progress of the program's implementation. Monitoring of each sentinel and check station within Harwich is proposed seasonally for the duration of the implementation phase. Monitoring of freshwater ponds is also anticipated. The water quality monitoring plan will be formalized as a written document provided to the TRC for review and comment. This water quality monitoring, or a portion thereof, may also be required by the groundwater discharge permit for the effluent recharge site(s). The results of water quality monitoring will be reported to the TRC annually in writing.

3. ***Habitat Monitoring:*** The Town anticipates that MassDEP will continue eel grass mapping, to assess the results of the Recommended Program's implementation. Benthic habitat monitoring may also be beneficial to evaluate the effects of the program's implementation. The feasibility and responsibility for such monitoring will be determined through discussion between the Town, CCC, and MassDEP.

4. ***Wastewater Treatment Plant/Groundwater Discharge Reporting:*** The Towns of Harwich and Chatham will be required through their groundwater discharge permits from MassDEP to develop regular compliance reports. These reports, typically developed monthly, will be submitted to MassDEP. Information contained in these discharge monitoring reports will include monthly WWTP flow rates (average daily and monthly) and influent and effluent quality (including, at a minimum, biochemical oxygen demand, total suspended solids, and total nitrogen). In addition, the groundwater discharge permit will require monitoring at specific groundwater wells and possibly also surface water bodies downstream of the discharge. These requirements will be specified by MassDEP during development of the permit and are anticipated to include both water quality parameters and groundwater elevations. Groundwater and surface water monitoring reports, as well as monthly WWTP discharge reports from the previous calendar year, will be submitted annually to the CCC and the TRC. In addition, a baseline report will be submitted to the CCC and the TRC containing monitoring data prior to bringing the new WWTP online.

5. ***CWMP Implementation and Funding Status:*** The TRC will be provided an annual implementation progress report following each calendar year containing an update regarding the implementation of the Recommended Program and the status of the project's funding. This report will include the following items:

   - The total length of sewer main pipeline installed to date and the length installed during the reporting year;
   - The total number of parcels with sewer available and the increase during the reporting year;
   - The total number of parcels connected to the sewer system and the increase during the reporting year;
   - The number of parcels connected to the sewer system broken down by watershed, and the increase by watershed during the reporting year;
   - The average daily influent flow to the WWTP during the reporting year, and the long-term trend of average daily flow from the first year of operation of the WWTP through the reporting year;
   - The estimated nitrogen removal by watershed, based on the number of parcels sewered, the influent flow to the WWTP, and the effluent flow and nitrogen concentration to the recharge site(s);
   - A description and status update regarding any other infrastructure-related improvements undertaken during the reporting year, such as construction of the Muddy Creek bridge and structural stormwater controls, and an estimate of the associated nitrogen removal;
   - A description and status update of any non-infrastructure components of the recommended program implemented in the reporting year, such as public education, fertilizer use reduction, and stormwater management, and an estimate of the associated nitrogen removal;

- Comparison of the estimated nitrogen removed to the results of water quality monitoring (with the understanding that due to groundwater travel times, results will not be immediate);
- The total dollar value of any funding approved during the reporting year for items associated with the recommended program;
- The approximate total dollar value of expenditures during the reporting year for items associated with the recommended program;
- An update regarding any regional initiatives; and
- The projects planned for the next two calendar years.
- The previous year's Implementation Progress Report will be included with any Project Evaluation Forms submitted to MassDEP for CWSRF funding consideration.

6. ***Community Growth Status:*** Each year, concurrent with preparation of the implementation progress report, a written update will be prepared and submitted to the TRC describing community growth both in the community at-large and within the sewered areas. This report will list permitted renovations (building additions, redevelopment, etc.) both within and outside of the sewered areas, to assess if growth control strategies for the newly sewered areas are effective. Actual growth will be compared to the community buildout analysis. The report will also describe any changes to growth-management by-laws or regulations during the reporting year. This report will be used to determine if additional growth control or targeted growth strategies may be necessary.

7. ***CWMP Recommended Program Modifications:*** Based on the information provided, the TRC may recommend updates or modifications to the CWMP Recommended Program over the course of the implementation phase. This is the intent of the AMP, to assist the Town in evaluating compliance with TMDLs and identify the need for adjustments or mid-course corrections to subsequent phases of the structural or non-structural components of the Recommended Program. The proposed scope allows the recommendations to be periodically reviewed and updated to reflect the actual program results. This approach will result in the most efficient, cost-effective and successful implementation to achieve the necessary water quality results.

13.9 Alternative Technologies

The Town supports the use of newer alternative technologies. That concept has been incorporated into this program. The collection systems will utilize high efficiency motors and will be optimized for the expected wastewater flows. In addition, the wastewater treatment facility is proposed to use SBR and MBR technologies, which are newer technologies and provide advanced nitrogen removal compared to conventional activated sludge treatment facilities. In the past few years, the Town has explored the possibility of using a wind turbine and a solar photovoltaic (PV) array to offset a significant portion of the power needs of the Town. During the review process for solar and wind, the Town decided not to move forward with the installation of a wind turbine and instead decided to install a PV array at the Harwich Landfill which is also referred to as the HR-12 site in this CWMP. An update on the status of the solar PV project is provided below. Note that the renewable energy

project is separate from the CWMP construction cost estimates and phasing contracts and will require a separate permitting and review process.

13.9.1 Solar Photovoltaic Array

The Town understands that it has a responsibility to continually look to improve its services, develop sustainable long-term solutions, and set a positive example for the community. In July of 2011, the Town entered into an energy management service agreement between Cape and Vineyard Electric, Inc. (CVEC) and Cape Solar Two. A copy of the executed solar power agreement is provided in Appendix F.

The Harwich Photovoltaic (PV) project is a 3.96 MW solar electric generation facility that will be located at the closed landfill on the western portion of the HR-12 site. This site is also the site of the proposed wastewater facility in Harwich. The solar PV facility will consist of approximately 14,000 solar panels mounted on the ground. The system will be designed to meet all local state and federal codes and regulations.

The agreement was executed through the CVEC which was formed out of a strategic planning process commissioned and undertaken by the Cape Light Compact because it wanted to stabilize electric rates for all its members and ratepayers with renewable energy generation. At the time, neither the Cape Light Compact, nor its member towns/counties, could develop electric generation projects and enter into long-term power purchase agreements. The Cape Light Compact is an active member of CVEC.

The 20 year energy management service agreement specifies that the Town, through CVEC, is entitled to purchase 3,910,000 kWh/year at an energy price of 6.90 cents per kilowatt hour. The agreement also specifies that the Town will receive all net metering credits for the energy generated at the site.

The solar array has not been constructed at this time, but it will ultimately provide the Town with a significant energy savings over the life of the project.

It is estimated that the Harwich project could annually save the Town up to $300,000 a year in electricity costs. The Town's current electric bill is about $850,000 a year. This project will also realize a significant reduction in greenhouse gas emissions for the Town and is being included as part of the CWMP recommended plan for greenhouse gas reduction.

13.10 Alternatives to the Recommended Program

Over the course of the CWMP development, the Town considered many alternatives to the system layouts and locations, to the selection of appropriate technologies for wastewater conveyance and treatment, to effluent recharge sites and uses, and to cost recovery approaches. Each of these alternatives is discussed in detail in the pertinent sections of this report. This section focuses on the large-scale alternatives to the recommended program. Specifically, the No-Build Alternative, regional alternatives, and options to sewering either more or less of the Town are discussed.

13.10.1 No-Build Alternative

The No-Build alternative involves the continued use of onsite Title 5 septic systems and innovative and alternative (I/A) systems where needed to meet the wastewater needs of the community. MassDEP

indicates that the baseline, or No-Build, alternative, which focuses on optimization of existing facilities, should be evaluated "with respect to potential effects on surface water quality; groundwater quality (if applicable); land use limitations; and socio-economic factors (e.g., residential, industrial, and health hazards)." None of these factors can reach an acceptable level of service under the No-Build alternative.

As shown in Figure 13-5, on-site treatment technologies cannot reliably meet the stringent nitrogen reduction standards on thousands of individual lots that are possible with more centralized, municipally-run treatment systems. While some I/A systems exist which provide better nutrient reduction than a typical Title 5 system, they still fall short of the requirements since they do not remove the 50 to 100 percent of the septic nitrogen load that is required in the MEP reports for Harwich. In Section 10, it was demonstrated in Scenario 7A that I/A systems could be utilized in all of the MEP studied watersheds except Wychemere Harbor which requires 100% removal of septic nitrogen. The analysis of Scenario 7A demonstrated that, while possible, I/A systems would still need to be supplemented with conventional wastewater treatment in order to achieve the TMDL. In that scenario, conventional wastewater treatment was minimized and the use of I/A systems was maximized. After reviewing that scenario, the Town decided not to pursue the I/A scenario because the cost was the highest among all options considered.

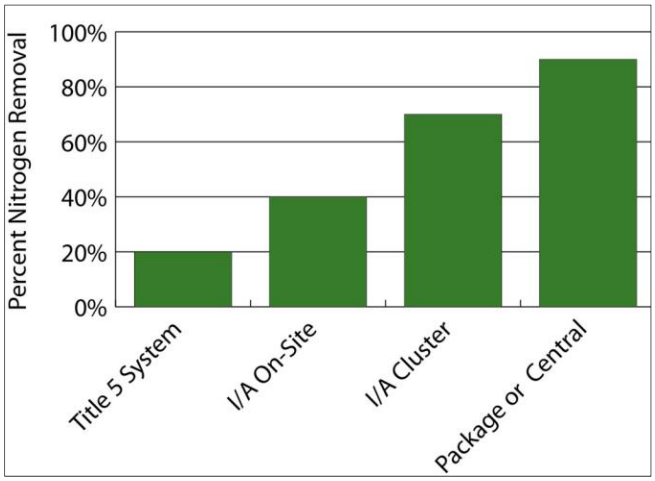

Figure 13-5
Percent Nitrogen Removal
For Several Treatment Technologies

As such, continued use of on-site systems town-wide would not be cost effective to achieve the nitrogen levels required to restore the local embayments to the highest and best use water quality goals described in the MEP documents. Based on this data, surface water quality cannot be adequately maintained using the No-Build alternative. In addition, the slightly elevated levels of nitrogen found in the towns drinking water supply and described in Section 10 suggests that nitrates in drinking water in Harwich could potentially become elevated particularly in areas where higher density development is desired. It is important to note that the need to protect drinking water quality in Harwich is not a significant driver for sewering at this time.

The No-Build alternative also presents land use limitations, specifically in the East Harwich Village Center, the Campground Area, the Route 28 corridor including Harwich Port and other areas of desired growth throughout town. Without off-site wastewater management options, desired land uses are expected to be severely restricted by Title 5.

The Town relies on tourism for jobs and revenue which is the direct result of the high quality natural resources on Cape Cod. Furthermore, many residents choose to reside in Harwich due to its natural beauty and the recreational opportunities afforded by its beaches, ponds and scenic waterways.

Protection of these resources is critical to the health and well-being of the Town. While the No-Build Alternative is obviously the least expensive option when only considering capital costs, the long-term impact on the economic viability of the Town must also be considered, along with the many qualitative factors related to aesthetics, quality-of-life, and environmental preservation. The No-Build Alternative would not adequately preserve these valuable resources, would be in violation of the TMDL requirements for the Town's five embayment's and is not considered a viable option by state and local officials.

13.10.2 Regional Solutions

In the recommended plan, the Town has explored the feasibility of a regional solution to address the wastewater needs identified in the Pleasant Bay and in the Herring River watersheds. The first is a regional treatment solution with the Town of Dennis for the western portion of the proposed sewer area that falls within the Town of Dennis limits. The recommended wastewater plan presented herein assumes that the Town of Dennis will collect wastewater in this area and will recharge the treated effluent in a watershed outside of the Herring River. This assumption is only preliminary and further discussions with the Town of Dennis will be required as the Town moves forward with development of their CWMP.

The second is a regional solution with the Town of Chatham for areas within the Pleasant Bay watershed, which is shared among Brewster, Chatham, Harwich and Orleans. The recommended wastewater plan presented in this section assumes that the Town will collect wastewater from the Pleasant Bay watershed and will send it to Chatham for treatment to a total nitrogen concentration of 3mg/l. The treated effluent will then be recharged in Chatham for the early phases of the project if timing and phasing of the projects permits. For the later phases of the project, the treated effluent may be required to be recharged back in the Pleasant Bay to ensure that the TMDL limits are not exceeded. Discussions with the Town of Chatham are in process and several options are being explored. At this time, both communities understand the benefits of utilizing a regional solution and both communities are interested in pursuing this regional solution.

13.10.3 Construct a Smaller or Larger Sewer Service Area

Over the course of the CWMP process, the Town explored many alternatives to the two wastewater treatment plant program ultimately recommended. Smaller, decentralized service areas with smaller decentralized treatment facilities were explored in detail in Section 10, where the Town looked at the scenario of having four different wastewater treatment plants and four different effluent recharge sites as well as an ocean outfall. In Scenario 7A, hundreds of treatment and effluent recharge locations were considered under the highly decentralized on-site I/A scenario. The cost for these decentralized approaches to wastewater management was higher than scenarios 3A, 4A and 5A which utilized no more than two centralized treatment facilities and no more than two effluent recharge sites. It should be noted that the two treatment facilities in the recommended program are relatively small and are less than 1.0 mgd (average day flow). The Town also felt that the effluent recharge sites HR-12 and PB-3 were ideal sites when compared with the other sites considered for effluent recharge. The other effluent recharge sites were more limited in terms of land use, land area redundancy and their potential to accept effluent flow.

The recommended program is already estimated to cost the Town $180 to $230 million over the course of the 40 year implementation period and any increase in treatment and disposal cost was

rejected in favor of a system that utilizes two treatment and two effluent recharge locations for simplicity. Furthermore, the benefit of decentralized treatment of promoting local recharge to groundwater is not inherently consistent with the MEP goal of reducing nitrogen inputs in specific locations. By providing centralized treatment and effluent recharge in only two sites, nitrogen loading to local waterways can be closely monitored and controlled. It also allows for future treatment of personal care products or other constituents should that be required.

On the other end of the spectrum is the remote possibility of sewering the entire town. Based on the analyses performed as part of this CWMP, there are no documented reasons at this time with respect to environmental protection or public health to sewer areas beyond those currently proposed. Sewering areas beyond those necessary to protect the local embayments, to allow for additional growth in East Harwich Village Center, the Route 28 corridor including Harwich Port and to address limited Title 5 or pond water quality issues, is considered cost-prohibitive and would provide no apparent benefit at this time to the Town. The Town is confident that, based on several years of analysis, the CWMP recommended program strikes the proper balance between providing sewers in the areas where they are needed and promotes continued septic system use in the areas where lower cost and lower technology strategies remain appropriate.